

Report of the Work of The Rubber Research Board in 1945

(Established under the Rubber Research Ordinance, Chapter 302)



November 1946

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THE present report is the fifteenth annual report of the Rubber Research Scheme (Ceylon) as constituted under the Rubber Research Ordinance (Chapter 302).

CHAIRMAN'S REPORT

Board Membership—The three-year period of the following nominated members of the Board terminated during the year and appointments to fill the vacancies were made as indicated below :—

Mr. W. N. Gunawardena, 18th May	—Mr. A.M. Clement Dias nominated.
Mr. J. L. D. Peiris, 18th May	—Mr. F. J. C. de Mel nominated.
Mr. W. P. H. Dias, 10th June	—Renominated.
Mr. F. H. Griffith, 15th Nov.	—Renominated.
Mr. F. A. Obeyesekere, 25th Nov.	—Renominated.

The following additional changes in the membership of the Board occurred during the year :—

Col. C. J. D. Lanktree, Acting Deputy Financial Secretary, was nominated to represent the Financial Secretary from 8th February, in place of Mr. C. E. Jones. Special reference was made to the valuable services rendered by Mr. Jones during his long period of membership.

Mr. W. Neal de Alwis was nominated on 24th February in place of Mr. S. F. H. Perera who had resigned in December 1944.

Mr. R. C. L. Notley left the island on leave and Mr. G. W. Aldridge was nominated to act for him from 22nd February. Mr. Notley returned and resumed membership on 22nd October.

Mr. W. H. Attfield resigned and Mr. R. P. Gaddum was nominated in his place from 2nd May.

Mr. E. W. Whitelaw left the island on leave and Col. K. D. H. Gwynn was nominated to act for him from 13th July.

Mr. L. P. Gapp resigned and Mr. E. J. O. Richardson was nominated in his place from 10th December.

The personnel of the Board at the end of 1945 was as follows :—

Ex-Officio Members:

The Director of Agriculture—(Mr. L. J. de S. Seneviratne, C.C.S.), Representing the Financial Secretary—The Deputy Financial Secretary (Col. C. J. D. Lanktree, C.C.S.).

Unofficial Members of the State Council nominated by H.E. the Governor :

The Hon'ble Mr. G. E. de Silva, M.S.C.
Mr. R. C. Kannangara, M.S.C.
Mr. G. R. Whitby, M.S.C.

Members nominated by the Ceylon Estates Proprietary Association :

Mr. R. P. Gaddum.

Mr. E. J. O. Richardson.

Members nominated by the Planters' Association of Ceylon :

Mr. F. H. Griffith, M.S.C.

Mr. R. C. L. Notley.

Members nominated by the Rubber Growers' Association :

Mr. R. J. Hartley.

Col. K. D. H. Gwynn; (Acting).

Members nominated by the Low Country Products Association of Ceylon :

Mr. T. Amarasuriya, M.S.C.

Mr. W. Neal de Alwis.

Mr. A. M. Clement Dias.

Mr. F. J. C. de Mel.

Members nominated by H.E. the Governor to represent smallholders :

Mr. W. P. H. Dias, J.P.

Mr. F. A. Obeyesekere.

Meetings—Meetings of the Board were held in Colombo on 12th March, 11th June, 10th September and 29th October.

Committees—

Experimental Committee—Messrs. W. N. Gunawardena and F. J. C. de Mel acted for Mr. R. C. L. Notley from 12th March to 18th May and from 11th June to 21st October respectively. The personnel of the Committee at the end of 1945 was as follows :—

Mr. F. H. Griffith, M.S.C., (Chairman).

Mr. W. P. H. Dias, J.P.

Mr. R. C. Kannangara, M.S.C.

Mr. R. C. L. Notley.

Mr. F. A. Obeyesekere.

The Director (Convener).

Meetings of the Committee were held on 15th January, 30th April, 11th June, 30th July, 16th October and 29th October.

Smallholdings Committee—There were no changes in the membership of the Committee which, at the end of the year, was as follows :—

Mr. W. P. H. Dias, J.P.

Mr. F. A. Obeyesekere.

The Smallholdings Propaganda Officer.

The Director (Chairman and Convener).

A meeting of the Committee was held on 3rd August.

Ad hoc Committee—A committee consisting of the Chairman of the Experimental Committee (Mr. F. H. Griffith, M.S.C.), the Acting Director and the Secretary-Accountant was appointed to consider the tenders for construction of certain buildings and the Hedigalla cart-road, and to award suitable contracts.

A meeting of the Committee was held on 11th July, 1945.

London Advisory Committee for Rubber Research (Ceylon and Malaya)—The Board contributed equally with the Imperial Institute to the cost of research on the quality and utilisation of raw rubber carried out at the Imperial Institute under the control of the London Advisory Committee for Rubber Research (Ceylon and Malaya). Meetings of the Advisory Committee and of the Technical Sub-Committee were held on 27th April, 1945.

Future development—The proposals for future development, as adopted by the Board, were published as a Special Circular and issued to all persons registered to receive the Scheme's publications. The Associations representing local rubber producers were invited to express their views, and final proposals providing for an increase in the research cess from 12½ to 25 cents per 100 lbs. for a period of ten years were placed before the Hon'ble the Minister for Agriculture and Lands.

FINANCE

Income—The Board's main income was derived from the cess of ¼th cent per pound on exports of rubber under Section 6(1)a of the Rubber Research Ordinance. Income from this source fell short of the estimate for the year.

Monthly cess collections were as follows :—

January	.. Rs.	29,131	Brought Forward	.. Rs.	119,252
February	.. „	16,788	July	.. „	26,422
March	.. „	25,229	August	.. „	30,933
April	.. „	10,681	September	.. „	15,690
May	.. „	14,560	October	.. „	19,076
June	.. „	22,863	November	.. „	23,501
			December	.. „	28,389
Carried over	.. Rs.	119,252		.. Rs.	<u>263,263</u>

A profit of Rs. 29,767/- was derived from the normal working of Dartonfield Estate and Rs. 27,338/- from Nivitigalakele.

Expenditure—Current expenditure amounted to Rs. 341,466/- leaving a surplus for the year of Rs. 2,081/-.

Capital expenditure amounting to Rs. 51,166/- was incurred mainly in respect of Agricultural Development Rs. 12,919/-, Construction of chummary for Research Assistants, 1 junior staff bungalow, carpenter's shed, labourers' and peons' quarters and drying house for crepe samples Rs. 19,449/- Alterations in experimental factory Rs. 2,500/-, Hedigalla cart road Rs. 4,844/-, Water and Power Supply Rs. 4,861/- and Laboratory Apparatus Rs. 4,768/-.

Accounts—The accounts, with a Balance Sheet showing the property and liabilities of the Board, have been prepared and submitted to the Auditor General for examination.

Technical Reports—The Director's report, which embodies the reports of the other officers, and the reports for 1944 and 1945 of the London Advisory Committee for Rubber Research (Ceylon and Malaya) are attached.

(Sgd.) L. J. SENEVIRATNE,
Chairman of the Board

RUBBER RESEARCH SCHEME (CEYLON)

March 14th, 1946.

DIRECTOR'S REPORT

The termination of world hostilities during the year opened the way towards the gradual restoration of normal conditions. The Research Scheme was handicapped by the absence of several members of the scientific staff and activities were correspondingly curtailed. Staff shortage will continue to be felt in 1946, but strenuous efforts are being made to recruit new personnel to fill vacancies.

The present report is on a war-time basis and includes a short summary of the work of each department compiled by the officer concerned.

Staff

Director—Mr. T. E. H. O'Brien was absent on sick leave from 23rd April until the end of the year (returned to duty 12th February, 1946). Mr. M. W. Philpott was in charge of the work of the Scheme during the Director's absence.

Chemical Department—Mr. M. W. Philpott returned from overseas leave on 20th April, 1945, and officiated as Acting Director from 23rd April.

Botanical Department—Mr. C. C. T. Sharp, Temporary Botanist, resigned his appointment on 10th November, 1945 to return to the service of the Rubber Research Institute of Malaya. Appreciation of the value of Mr. Sharp's services was placed on record by the Board.

Dr. C. E. Ford, Geneticist, proceeded on overseas leave on 20th July, 1945 and was absent for the remainder of the year. (At the request of the Colonial Office Dr. Ford has since been permitted to resign his appointment with effect from 19th March, 1946 to take up special work elsewhere).

Mr. C. A. de Silva, Assistant Botanist, was on duty during the year.

Soils Department—Dr. L. A. Whelan, Soil Chemist, was on duty up to 30th December, when he proceeded on overseas leave.

Smallholdings Department—Mr. W. I. Pieris, Smallholdings Propaganda Officer, was on duty during the year.

Estate Department—Mr. G. P. N. de Silva, Estate Superintendent, was on duty during the year.

Headquarters Office—Mr. C. D. de Fonseka, Secretary-Accountant, was in charge of administrative work during the year.

CHEMICAL DEPARTMENT

M. W. PHILPOTT

Variability, and the Improvement of Hevea by Selection

In the chronicle of plantation research no subject is more frequently reviewed than that of variability. Although the problem has been studied since the early days of rubber growing investigators have so far only succeeded in defining a few of the natural and artificial variables which affect technical quality. The causes as distinct from the manifestations of variation are still only vaguely understood.

Even so, enough is known about the factors involved to indicate the lines on which estate technique should develop in order to raise the general standard of uniformity. If commercial rubber is scarcely less variable today than it was thirty years ago it is mainly because rubber growers are not yet ready to face the reorganisation of production methods which most plantation technologists would prescribe.

In these circumstances it is questionable whether much benefit is likely to accrue from a continuation of research on variability from the point of view merely of its elimination.

An alternative approach was briefly adumbrated in the report for 1943 and may now be discussed in more detail. It has been mentioned that variability research in the past had no other object than to improve the standard of uniformity of plantation rubber. In recent years however investigators have begun to exploit the idea of deliberately accentuating natural variations instead of suppressing them. Since rubber varies in quality according to its source and mode of preparation, one might expect to find particular variants which are significantly better than average rubber for particular uses. If that is so it is of special interest to ascertain whether tree to tree differences in Hevea are regulated by hereditary factors, and if so whether valuable clones cannot be developed from trees which synthesise rubbers of specially

desirable type. In other words, it is asked whether the methods of the plant breeder which have been so successfully employed to increase the productivity of rubber estates cannot also be used to solve the more complex problem of improving quality.

Impetus to these ideas was provided by the results of investigations on African Rubbers undertaken during the war by the staff of the London Advisory Committee. These workers showed that rubbers of widely separated botanical origin behave very differently in regard to vulcanisation and reinforcement, despite the fact that they all appear to be polyisoprenes, like Hevea.

Before we can proceed to assess the scope for modifying the properties of Hevea rubber by selection we must know something about the nature and extent, of the differences between rubbers from different trees. In particular we must discover whether the differences are technically significant and whether they are genetically controlled.

The full technical evaluation of single tree samples requires special equipment which is not yet available in Ceylon. The main objective of the Chemical Department during 1944 and 1945 therefore was to collect and examine samples from selected families, from mother trees and their vegetative offspring, and from a large number of trees of unknown genotype.

The criterion chosen for the initial classification was the hardness index (D10) which is measured by the parallel-plate plastimeter. This property (often loosely called the plasticity) has two important advantages: it is easy to determine, and we believe it to be related to the character of the rubber hydrocarbon itself rather than to the accessory substances. In the absence of a satisfactory theory of plastic flow it is impossible to interpret differences in stress flow properties in terms of molecular structure but nevertheless there is experimental evidence to show that for rubber samples prepared in a standard way the hardness index is closely related to the solution viscosity, and hence, we may assume, to the length of the polyisoprene chains.

Mixed Seedling Trees—The first attempt to determine the range of plasticity variation among mixed seedling trees was made by Hastings in 1942. Out of about 10,000 mature trees at Dartonfield 268 of the best yielders were chosen for the investigation. Latex from each tree was separately coagulated, creped, and dried under standard conditions. Plasticities were determined 3 to 4 weeks after preparation by compressing 2 c.c. pellets at 100°C under a load of 5 kgm. The hardness (plasticity) was recorded as D10, the thickness of the specimen in millimetres after 10 minutes compression.

The main limitation of Hastings' survey was that it covered a rather small number of trees, all of which were known to be good yielders. As it cannot be assumed that plasticity and yield are independent it was thought desirable to examine a larger and more random group of unselected seedling trees.

Material for such a survey was taken by the courtesy of the Manager of Galla-watta Estate from an area adjacent to Dartonfield. The trees were about 38 years old and stood in a single block. Out of 1,115 trees in the area 272 were found to yield insufficient rubber for the plasticity test; the remaining 843 trees were sampled by the standard technique, records being made of the yield of rubber at a single tapping, the latex dry rubber content, and the hardness (D10) of the rubber. At the time of the survey the trees had been tapped "double-3" (2S/2, d/3, 133%) for 3 years; prior to that (1931—1941) they had been on "double-4".

Though yields were recorded principally for correlation purposes, it is interesting to note that the observations confirmed broadly the findings of other investigators who have studied the distribution of yields in seedling rubber. (Whitby; Bryce and Gadd; De la Rue, etc.) In the group of 1,115 trees, the 25 per cent highest yielders gave 58.5 per cent of the total yield; and the 50 per cent highest yielders gave 86 per cent of the total yield. One tree in four gave less than 5 gms. of rubber per

tapping ; the remainder gave yields varying from 5 to 168 gms., with a mean of 36.8 gms. and a coefficient of variation of 72.3 per cent. The distribution was positively skew.

Variations in D.R.C. were studied because there was evidence from earlier work of a relationship between plasticity and latex D.R.C. Among the 843 trees which yielded at least 15 c.c. of latex the lowest D.R.C. obtained was 13.6 per cent (gms. of rubber per 100 c.c. of latex) and the highest 50.6 per cent. The mean D.R.C. was found to be 35.78 ± 5.80 per cent.

The 843 trees yielded samples of rubber possessing D10 values varying from 2.15 to 5.15. The mean was 3.624 ± 0.486 , and the coefficient of variation 13.4 per cent. The observed distribution of D10 was found to be significantly non-normal, more rubbers having D10 values in the neighbourhood of the mean $\pm$ standard deviation than would be expected on the normal theory, and correspondingly fewer having values near the mean. The 1942 survey of Dartonfield high yielders showed the same type of deviation from normality.

The results of the survey are set out in Table I together with those of the 1942 survey. As the two groups of trees were of similar age (30 to 38 years) and grew in

TABLE I

Variation in Plasticity (D10) among Mature Seedling Trees						
Seedling Group	No. of Trees	Tapping System	D10 (mm)			C. of V. per cent
			Mean	Range	s	
Unselected (Gallawatta)	843	Double—3	3.62	2.15 to 5.15	0.486	13.4
High Yielders (Dartonfield)	268	Double—4	3.86	2.44 to 5.29	0.537	13.9

the same locality the difference in the means is at first sight anomalous, differing as it does by more than the error of random sampling. The difference is probably to be ascribed to the greater intensity of tapping at Gallawatta ; for there is evidence that hardness tends to decrease with more frequent tapping.

These surveys showed that in any mixed seedling stand we may expect to find individual trees yielding rubbers whose hardness values differ among themselves by at least 100 per cent. Superficial examination of the single tree samples showed that whereas the hardest were extremely tough, the softest resembled normal rubber that had been lightly masticated. From the limiting viscosities of the benzene sols, which ranged from about 3.5 for the softest samples to about 7.0 for the hardest, it seems that the weight average molecular weight of the hardest rubbers may be twice that of the softest.

Seedlings of limited parentage—Field studies were next extended to a group of seedling trees from which clones had already been established. These trees were grown from seed derived from plots B & C of the Prang Besar Isolation Gardens in Mulya. The seedlings were planted at Nivitigalakele in 1935 as two year old stumps and were brought into tapping in March 1940. The parentage of the seed from plot C, which contains 14 inter-planted clones (PB. 8, 16, 23, 24, 25, 28, 31, 38, 49, 56, 86, 123, 186, and SR. 9) is known only on the female side ; plot B seed on the other hand is the self-fertilised seed of clone SR. 9 and its parentage is therefore fully known.

When the variation for each family was estimated as in Table II it became evident that a family of individuals derived from a single seed parent may be as variable as

TABLE II

Serial Nos.	Family	No. in family	D10 (mm)			Coefft. of Var. %
			Mean	Range	Stad. Dev.	
1—24	P.B. 8—illeg.	21	3.78	2.60—4.47	0.537	14.2
25—26	P.B. 23— „	2	—	—	—	—
27—45	P.B. 24— „	14	3.89	2.50—4.75	0.667	17.2
46—47	P.B. 25— „	2	—	—	—	—
48—57	P.B. 31— „	9	3.12	2.52—3.64	0.346	11.1
59—74	P.B. 38— „	13	3.43	2.60—4.24	0.521	15.2
75—90	P.B. 56— „	9	3.28	2.60—3.62	0.383	11.2
91—113	P.B. 86— „	22	3.81	2.64—4.56	0.371	15.0
114—121	P.B. 123— „	8	3.96	3.64—4.45	0.478	12.1
183—197	S.R. 9— „	13	3.47	2.76—4.20	0.432	12.4
123—182	S.R.9 X S.R.9	41	3.42	2.17—4.35	0.594	17.4
1—197	All families	154	3.59	2.17—4.75	0.582	16.2

any random group of trees of mixed heredity : and that a legitimate family such as SR.9 X SR.9 whose members have a common parentage may exhibit as much variation as a mixed seedling population. This result is of importance because it shows that breeding is not likely to be practical as a means of securing particular latex properties.

Seedlings and Budgrafts—A problem of more immediate interest was that which concerns the relationship between mother trees and their vegetative offspring. In 1936/1937 budwood from each of the Prang Besar Isolation Garden (P.B.I.G.) seedlings at Nivitigalakele was used for establishing small clones. Those buddings which yielded sufficient rubber in 1944 were sampled and tested. Altogether 113 clones, each of 3 trees, were available for comparison with the mother trees from which they originated.

The correlation of mean clonal hardness with parent seedling hardness is shown in Table III to be of a high order : from which we may confidently assume that hardness, and hence any property associated with it, is genetically controlled.

TABLE III

P.B.I.G. Mother Trees and Clones : Plasticity (D10) Correlations			
	Coefficient	Standard Error	P
Correlation coefficient, Regression of mean Clonal on parent D10	0.472	—	< <0.001
	0.503	0.043	< <0.001

Intra-Clonal Variation—We are thus led to anticipate that rubbers obtained from the individual members of a single clone will be substantially uniform in properties. If there are any intra-clonal variations at all they will probably be due to secondary factors such as soil environment, stock influence, pathological conditions and tapping history.

For the investigation of intra-clonal variation samples were taken from individual trees of clonal blocks at Dartonfield and Nivitigalakele. Six trees were sampled in each of eight separate blocks of clone AV. 50 in the 1935 clearing at Nivitigalakele. After eliminating the block variance, the variance within blocks was found to be equivalent to a coefficient of variation of 4.1 per cent.

Trials with other clones are summarised in Tables IV and V. In one set of trials the pooled estimate of variation was calculated to be 4·7 per cent and in the other 4·3 per cent.

TABLE IV

Plasticity (D10) of Rubber from Established Clones										
	Dartonfield 1934 Clearing			Nivitigalakele—1928 Clearing						
	AV. 256	GL. 1	PB. 25	PB. 23	PB. 25	PB. 186	BS. 3	MK. 3/2	HC. 28	WG. 6278
	3·19	2·99	3·57	4·08	4·00	3·15	3·94	3·86	3·02	4·42
	3·57	3·24	3·74	3·55	3·79	3·24	4·10	4·25	3·07	4·06
	3·84	2·86	4·02	3·75	3·89	3·06	3·90	3·73	3·48	4·23
	3·93	3·00	4·11	3·57	3·97	2·79	3·74	3·94	3·17	4·21
	3·38	3·24	3·62	3·98	3·82	2·94	3·85	4·13	3·32	4·42
	3·18	3·14	3·64	4·11	3·89	2·83	3·90	3·95	3·07	4·55
	Average	3·52	3·08	3·78	3·84	3·89	3·00	3·91	3·98	3·19
					S.S.	D/F	M.S.		C. of V. %	
Between Blocks					10·24	9	1·14		4·7	
Within Blocks					1·96	50	0·0292			
Total					12·20	59	0·207			

TABLE V

Plasticity (D10) of Rubber from Mature Clones
at Nivitigalakele 1926 Clearing

	H. 2	Cuilgagh 4	Lavant 28	Gov. 771
	4·13	3·16	3·67	3·06
	4·48	3·22	3·73	3·11
	4·24	2·89	3·57	3·26
	4·39	3·19	3·57	3·10
	4·37	3·34	3·96	3·25
	4·46	3·37	3·64	3·24
	4·18	3·19	3·68	3·19
	4·35	2·92	3·55	3·19
	4·58	2·93	3·63	2·79
	4·08	3·01	3·63	2·97
Average	4·33	3·12	3·66	3·12
	S.S.	D/F	M.S.	C. of V. %
Between Blocks	9·86	3	3·29	4·3
Within Blocks	0·84	36	0·0233	
Total	10·70	39		

It thus appears that within monoclonal blocks we may expect to find tree to tree variations corresponding to a coefficient of variation of 4 to 5 per cent. ; but as this variation hardly exceeds the standard error of the determination the data cannot be said to provide any evidence of intra-clonal variation such as might result forexample, from stock differences.

Plasticity and Dry Rubber Content—Early in the investigation it was noticed that trees giving hard rubbers often had latices of high D.R.C. For example the ten hardest trees in the P.B.I.G. seedling group had a mean latex D.R.C. of 40.6 ± 4.0 per cent. ; while the ten softest had a mean of 32.3 ± 5.3 per cent.

TABLE VI

Per Cent. Total Solids Content of Latices
from Hard and Soft Trees

Soft Rubbers			Hard Rubbers		
Tree No.	D10	T.S.	Tree No.	D10	T.S.
1A/1046	2.76	30.0	6/1958	4.48	26.8
3/170	2.76	39.0	1A/1063	4.57	52.1
3/404	2.91	36.3	6/1712	4.59	40.7
3/1279	2.94	38.4	1A/112	4.65	42.4
3/3056	2.96	37.8	1A/1093	4.71	44.3
6/258	3.19	41.3	1A/1051	4.74	41.6
1/30	3.21	37.4	1A/3	4.80	44.6

Table VI refers to twelve hard or soft Dartonfield trees sampled at fortnightly intervals over a period of 3 months. The table shows that most of the hard rubbers were associated with latices of high concentration, and *vice versa* ; it also shows that high latex concentration cannot be regarded as an essential condition for the production of hard rubber (cf. tree No. 6/1958).

The most positive evidence of association however was provided by the Gallawatta data. In this group of 843 trees hardness and D.R.C. were found to be correlated with a coefficient of 0.254 which is highly significant (Table VII). The corresponding linear regression equation could be written,

$$\text{D.R.C.} = 3.99 \text{ D10} + 21.36$$

where D10 is expressed in mm and D.R.C. in gms for rubber per 100 c.c. of latex.

TABLE VII

Gallawatta Survey

Correlation between	Coefficient	P
Hardness (D10) and Yield	0.0187	Not Signif. 0.01
Hardness (D10) and D.R.C.	0.254	

Why hard rubbers should be synthesised chiefly by trees which secrete latex of high concentration is not understood.

Plasticity and Yield—Hastings' suggestion that high yielding trees tend to give hard rubbers was not supported by the Gallawatta data. The absence of association between hardness and yield was indicated by the low value obtained for the correlation coefficient (Table VII), and was confirmed by the fact that the mean hardness of the highest yielders was almost the same as that of the whole population (Table VIII).

TABLE VIII

Gallawatta Survey				
	No. of trees	D10 (mm)		
		Mean	Range	S
Highest Yielders (> 80 gms)	64	3.635	2.67 to 4.81	0.501
Total Population	843	3.624	2.15 to 5.15	0.486

Plasticity and Height of Tapping Cut—In some trees where there were marked differences in the level of the two tapping cuts it was noticed that the latex from the higher cuts tended to give harder rubbers than latex from the lower cuts.

The influence of height of cut was therefore studied by taking latex from six trees in a "ladder tapping" experiment. At the time of sampling the trees had been tapped for 10 months every third day on three cuts—two normal (low level) half circumference cuts and one half circumference cut opened at a height of 8 feet from the ground (Table IX).

TABLE IX

Tree No.	D10 (mm)		
	Lower (normal) cuts	Upper (8 ft.) cuts	Difference
LT/1	2.67	3.88	1.21
LT/8	3.48	4.10	0.62
LT/40	4.09	4.54	0.45
LT/45	4.31	4.65	0.34
LT/46	3.42	3.42	0.00
LT/52	2.83	3.28	0.45

In another trial seven trees, intensively tapped on two normal and two "upward" cuts located above the tapping panel, were sampled on six successive tapping days. Hardness and latex D.R.C. were found to be uniformly higher for the "upward" cut (Table X).

TABLE X

Tree No.	D10 (mm)		D.R.C. (per cent.)	
	Normal Cuts	"Upward" Cuts	Normal Cuts	"Upward" Cuts
754	3.43	4.48	31.6	38.9
830	3.35	3.53	34.6	38.9
1072	3.77	4.03	43.3	44.1
1091	3.61	3.89	36.2	36.2
1176	2.95	3.28	35.0	35.3
1179	3.92	4.70	32.7	34.7
6/1958	4.16	4.81	22.2	36.7

It thus appears that latex characteristics are not uniform throughout the tree but depend in part on the position of the tapping cut. The hardness variation within a single tree is however less than the variation between trees.

Selected Hard and Soft Trees—A few trees at Dartonfield which are known to produce very hard or soft rubbers were sampled at monthly intervals to see what seasonal or other fluctuations occur in the latex properties. During the year ending April, 1945 the hardness values showed a slight tendency to fall but there was no evidence of seasonal change. The slow decline may have been due to the relatively intense system of tapping (2S/2.d/3,133%) employed during the period of observation.

Changes in D.R.C. appeared to be seasonal in the sense that D.R.C. was related to rainfall. In the D.R.C. of individual trees there were also small irregular fluctuations, unconnected with rainfall, which were usually accompanied by fluctuations in hardness. From a statistical examination of these fluctuations it was concluded that factors which depress the D.R.C. of the latex in the tree also depress the hardness of the rubber, and *vice versa*.

Interpretation of Plasticity Data

The assumption was made in the last section that differences in stress-flow behaviour reflect deep-seated differences in the rubber hydrocarbon. As this assumption was based on somewhat scanty evidence it was decided to try to define more exactly what is implied by stress-flow variations, and particularly by such variations as may be detected with the parallel plate plastimeter. Although a fundamental treatment of the problem was beyond the scope of the present investigation it was thought that a limited extension of earlier work would be both possible and desirable.

This work, to which a considerable amount of time was devoted, need not be discussed here in detail. Its purpose was to discover whether compression-time relationships could be represented in a manner which would elucidate the true rheological properties of the material and provide a basis for the rational classification of rubbers. It cannot be said that the results so far have been very conclusive. While most of the work was based on Scott's classical analysis of compression-flow data, attention was also given to Williams' empirical equation, and (following Buist and Seymour) to the application of the Scott Blair-Nutting equation.

These equations fitted the data with a fair measure of accuracy but it was found that the numerical value of the constants depended to a great extent on the conditions of the test. Thus for one sample of raw rubber the time exponent k of the Nutting equation changed from 0.095 to 0.159 for an eightfold change in the applied stress. In these circumstances experimentally determined constants can have no absolute significance.

But when testing conditions were made strictly comparative, useful results emerged. It was shown for example that naturally soft rubber was not rheologically equivalent to normal rubber softened by mastication; at 100° none of the rubbers examined, whether raw or masticated, exhibited a yield value; the temperature dependence of viscous flow for all Hevea rubbers in the range 70° to 120° led to a calculated value of 12 ± 2 kcal. for the energy of activation.

An incidental conclusion drawn from this work was that despite the limitations of the parallel-plate plastimeter its possibilities have not yet been fully explored or exploited.

Estate Manufacture

Temporary Preservation of Field Latex—It is generally recognised that in sheet manufacture uniformity of product is best secured by the large-scale bulking of latex. In practice, owing to the tendency of latex to ferment and coagulate spontaneously, the scale of centralised production is limited by the time that it takes to collect and transport field latex to the factory. Clearly if suitable means of producing first grade sheet from, say, one day-old latex could be devised, the scope for centralised sheet production could be much enlarged.

Although many substances effectively retard the changes which lead to the spontaneous coagulation of field latex none is entirely free from objection. Among the materials which are commonly proposed as anticoagulants ammonia and formalin have the advantage of being volatile. Added in the proportion of 0.15 per cent on the latex both preserve latex sufficiently well for IX sheet to be made from day-old latex. Coagulant dosages need to be increased by 50 per cent with formalin and by 200 per cent with ammonia. Formalin produces quick drying, soft (low D10), slow curing rubber; ammonia tends to increase hardness and rate of cure.

An anticoagulant like formalin which possesses antiseptic properties has certain obvious advantages in estate manufacture. Experience at Dartonfield has shown that it is almost impossible to produce the common defects (bubbles, rust, mould etc.) of smoked sheet when latex is treated with formalin.

Some workers have objected to the use of formalin because it reduces the rate of cure by hindering maturation (De Vries) or because it is thought to affect the technical properties adversely (Leniger; Sackett). On the other hand "USF Rubber" (B.P. 549, 162) which suffers prolonged contact with formalin is claimed to be a rubber of exceptionally good quality. In tests made at Dartonfield formalin and ammonia-treated rubbers showed no abnormality in ageing properties.

It is concluded therefore that wherever circumstances arise which preclude the rapid conversion of estate latex to coagulum, smoked sheet of IX appearance may still be produced if formalin is used as a temporary preservative. It remains to be demonstrated by modern methods of evaluation whether formalin treated rubber is technically inferior to standard rubber.

Fermented or Matured Rubber—Fermentation is the commonest cause of bubbles in smoked sheet and the conditions of preparation are therefore usually arranged to minimise its incidence. It is noteworthy however that some users have claimed technical superiority for bubbly (fermented) sheet and that one large manufacturer has gone so far as to pay a premium for fermented sheet prepared by a special method.

A series of laboratory and factory scale trials was carried out at Dartonfield with the object of reviewing the known procedures for making fast curing fermented sheet commercially. In regard to the means available for promoting or preventing maturation these trials mainly confirmed the early conclusions of Eaton and his co-workers, but they also brought out the additional point of interest that there is an optimum temperature for maturation at about 40°C (Table XI).

TABLE XI

EFFECT OF MATURING TEMPERATURE

D.R.C. of Latex	Coagulant	Maturing Temperature (2 days)	D10	AM Test Mixing : 60 min. at 127°		
				T7 kg. per sq. cm.	B kg. per sq. cm.	LB
15 per cent	Acetic Acid 1: 180	10°	3.57	88	200	9.53
"	"	20°—25°	3.53	107	220	9.39
"	"	30°	3.67	124	205	8.98
"	"	40°	3.57	126	197	8.85
"	"	50°	3.37	102	201	9.27
20 per cent	Sugar 1: 100	10°	3.80	116	211	9.14
"	"	20°—25°	3.63	123	225	9.19
"	"	30°	3.73	133	206	8.84
"	"	40°	3.83	138	212	8.84
"	"	50°	3.64	108	208	9.24

The literature dealing with estate manufacture contains many references to the vulcanising properties of fermented or matured sheet. But the methods formerly used for technical evaluation cannot be considered adequate by modern standards. In view of the revival of interest in fermented sheet it might be opportune to subject this type of rubber to a comprehensive technological investigation, with particular reference to its interactions with reinforcing agents and with accelerators of different type.

The early workers demonstrated that fermented rubber had fast curing properties in simple rubber-sulphur mixings. Tables XII and XIII illustrate the fast curing (high modulus) characteristics of fermented rubber in (a) a standard mercaptobenzthiazole test mixing and (b) a technical MBT mixing.

TABLE XII

MERCAPTOBENZTHIAZOLE TEST MIXING (AM)						
	45 mins at 127°			60 mins at 127°		
	T7	LB	B	T7	LB	B
Normal Smoked Sheet ..	46	10.14	143	53	10.08	160
Fermented Smoked Sheet ..	105	9.37	214	122	9.09	215

TABLE XIII

TECHNICAL MBT MIXING (GAS TUBING)									
	5 mins at 141°			10 mins at 141°			20 mins at 141°		
	T5	LB	B	T5	LB	B	T5	LB	B
Normal Smoked Sheet ..	55	7.87	116	72	7.85	146	86	7.73	160
Fermented Smoked Sheet ..	83	7.58	149	97	7.57	171	103	7.72	164

Table XIV brings out the point that in the presence of diphenylguanidine fermented rubber cures more slowly than normal rubber; an observation which re-emphasises the frequently forgotten fact that the evaluation of a particular rubber may largely depend on the nature of the test mixings employed.

TABLE XIV

DIPHENYLGUANIDINE TEST MIXING						
	45 mins at 141°			60 mins at 141°		
	T7	LB	B	T7	LB	B
Normal Smoked Sheet ..	153	8.59	192	188	8.26	207
Fermented Smoked Sheet ..	138	8.77	201	175	8.34	200

Meteorological Observations

The weather summary for 1945 is shown below :—

	1945	1944
Rainfall (ins.) ..	134.9	197.7
Highest monthly rainfall (ins.) ..	29.1 (Oct.)	49.4 (May)
Highest daily rainfall (ins.) ..	6.55 (28.10.45)	7.37 (23.5.44)
Highest shade temperature (day) ..	94.7°F(23-25.2.45)	93.2°F(21.3.44)
Lowest temperature (night) ..	60.8°F (26. 1 45)	60.7°F(26.1.44)
Number of rainy days ..	210	254

BOTANICAL AND MYCOLOGICAL DEPARTMENT

C. C. T. SHARP

C. A. DE SILVA

C. E. FORD

Oidium—In contrast to 1944 damage by Oidium was very light in all districts, and the new foliage was the healthiest which has been seen for several years. This result was associated with hot, dry weather which favoured early wintering and quick refoliation. At Dartonfield there was a sharp attack of Oidium in the latter part of February, following light showers, but only a few late wintering trees and clones were affected.

Leaf and pod disease was also very mild, as might be expected in a season of low rainfall.

Bark Canker—An abnormal form of bark canker of untapped budded trees was examined on an estate in the Kalutara district. The first symptom was the appearance of vertical cracks in the bark usually near the base of the tree. Investigation showed that a fungus, believed to be a *Phytophthora* was spreading through the inner cortex for a distance in some cases of well over a foot. In most cases the greater part of the diseased tissue lay under apparently healthy bark and could not be detected until the outer layer of tissue had been removed. Similar symptoms were observed on one other estate in the district and on a few trees at Dartonfield. In each case the affected trees were in very damp situations. No trace of the disease was found on three other estates in the district which were visited for the purpose of checking up on its incidence.

Brown Bast—There were reports of increases of Brown Bast in budded and clonal seedling areas, and this is a matter for some concern. A number of experiments were initiated during the year, including a trial of the light scraping treatment recommended by the late H. W. R. Bertrand. The experiments are not yet at a stage at which they can usefully be reported on. An Advisory Circular was issued laying special stress on the importance of frequent counts of the number of trees with dry patches on the tapping cut ; and advising the adoption of a milder system of tapping if the number of affected trees exceeds $7\frac{1}{2}\%$ of the total stand.

PLANTING MATERIAL

Studies of clones and seedling families—1,773 trees were test-tapped during the year at Nivitigalakele, consisting of 60 local and imported clones, Tjikadoe and Prang Besar isolated garden seedlings and new clones derived from Tjikadoe and Prang Besar seedlings. Trees test-tapped in 1945 for the first time include 29 clones established from Tjikadoe seedlings in the 1939 clearing. The yields for the first 6 months show that 5 of these clones have given yields equal to or better than the best of the control clones, Glenshiel 1. Yields of the remaining clones in the 1935 clearing, Nivitigalakele, were disappointing and test tapping will be discontinued in 1946. The original budgrafts of clones MK. 3/2 and WG. 6278 at Nivitigalakele have given satisfactory yields for the tapping year 1944—45. The trees of the former were tapped on renewed bark.

New Trials—6 clones established from Prang Besar seedlings at Nivitigalakele selected in 1944 were planted in a large scale clone trial at Hedigalla, with clone TJ. 1 as control. The layout is a balanced incomplete block design with 3 replications of 20 tree plots of each of the 7 clones with double rows of boundary trees.

The planting of a "Crown-Budding" experiment was completed in December. The experiment is designed to investigate the influence of crown-budding on the yields of 'centre-sections' provided by budgrafts of 3 high and 3 low yielding clones. There are 18 replications of the centre-sections and 3 replications of the high budded clones forming the crowns. The crown-budding will be carried out with the same clones after 2 to 3 years at a height of 6 to 8 feet.

Breeding—Weather conditions were very favourable for pollination and the programme carried out by the Geneticist in 1945 showed greatly improved results compared with the previous year. Fifteen per cent of over 30,000 pollinations made were successful, from which 9,463 seeds were obtained; 57% of these germinated and just over 5,000 seedlings were finally established in a nursery. The seedlings represent about 60 families, which include some of the older A.V.R.O.S. clones, known to be good parents, clones TJ. 1, PB. 23 and BR. 2, Prang Besar new series clones, R.R.M. '500 series' clones, clones established from high yielding Prang Besar seedlings and some of the newer imported clones, AV. 255, 352, KD. 1, and P.R. 107, recommended for commercial planting on a small scale. The majority of the pollinations were made on trees of clones PB. 5/139, PB. 86 and AV. 163.

No. 3 Replanting Experiment, Dartonfield, (1936)—Three methods of establishing budgrafts in the field are compared. The girth measurements taken in May 1944 and 1945 are summarised in Table I.

TABLE I

	Age May 1945	Mean Girth in Inches		
		1944	1945	Increase
Stumped buddings ..	9	25.16	26.53	1.37
Budded stumps ..	9	23.73	25.39	1.66
Field buddings ..	8½	20.39	22.22	1.83
Sign. diff. 99 to 1 odds ..	—	1.46	1.44	0.26

The stumped buddings and budded stumps were taken into tapping in March 1942 and December 1942 respectively, and the field buddings in December 1943.

STOCK-SCION RELATIONSHIP

Stock Experiment, Dartonfield, 1941—In this experiment stocks of 5 different illegitimate families and unselected seedlings were budded with 5 clones of R.R.M. 500 series and planted in randomised sub-blocks of 6 single tree plots in five mono-clonal blocks, in June 1941. Unbudded seedling stumps of the same origin were planted at the same time. Girth measurements taken in June showed that the relative differences between the buddings on the 6 stocks had evened out during the past year and there was no indication that the growth differences in this experiment would be of practical importance. Some of the differences in growth between the unbudded stock families remained significant. Seedlings of clones AV. 163, TJ. 1 and BD. 10 were among the better growers.

TAPPING EXPERIMENTS

1. **Mature Seedling Rubber, Dartonfield, 1937**—The eighth year of this tapping experiment was completed in February. The results have been published in the Combined First and Second Quarterly Circulars for 1945. The yield of the Double Three system was 111.4 per cent of the control compared with 120.6 per cent in the previous year. This was tentatively attributed to the opening of a high percentage of new cuts in this system, thus increasing the average height of cut. Results in later years will show whether this explanation is correct. The average increase of 19% over the whole period of eight years was statistically significant. A number of trees in the area were blown down in a cyclonic storm, but it is hoped that this will not seriously affect future results.

2. **New Intensive Tapping Experiment**—The commencement of this experiment was reported in 1944. Trees tapped on double-three and double-four previously were used. Two upward cuts just above the normal tapping panel and two downward cuts were tapped alternately at 400 per cent and 200 per cent intensity, compared with a control tapped normally at 200 per cent intensity, until the tree yielded below 10 grams per tapping, when upward cuts were opened. The results for the tapping year with comparable results for the corresponding period in the first experiment with normal downward tapping are given in Table II.

TABLE II

	Experiment 2 (1944—45)		Experiment 1 (1942—43)
	lbs/acre	As %	As %
I. 2S/2,d/1, (2xd/2)400%	1,469.2	135	122
II. 2S/2,d/2, (2x2d/4)200%	1,194.7	109	—
III. 2S/2,d/2,200% ..	1,091.2	100	100
Sign. diff. (.01) ..		15.7	13.3

The value of upward tapping for short periods of slaughter tapping is clearly demonstrated.

3. **Intensive Tapping Experiment, Nivitigalakele**—This experiment was set up to compare tapping two upward and two downward cuts alternately or on the same day on the following systems :

System I, 2S/2,d/1,(2x2d/4)400%—the upward cuts tapped one day and downward cuts the next.

System II, 4S/2,d/2,400%—all four cuts tapped on the same day but trees tapped on alternate days.

The experiment was discontinued after 5 months owing to a loss of trees from wind damage. The results showed an increased yield of 19 per cent for tapping four cuts on the same day at the same tapping cost.

4. **Tapping Experiment No. 13 (Yield Stimulation), Dartonfield**—In this experiment yield stimulation with applications of coconut oil was more effective than with mineral oil. A 12-inch grooming below the tapping cuts, with applications of coconut oil at 6 weekly and 12 weekly intervals, gave an average increased yield of 1.8 pounds per tree in the first tapping year, 1944. Re-grooming and continuation of the experiment gave increased yields of 30% over the control with coconut oil in the first 4 months, but the stimulation from further applications was sporadic and showed no significant increased yields over the control for the last 7 months of the second tapping year. Apart from the formation of a hard outer crust which caused some difficulty in tapping most trees showed no adverse symptoms at the end of the second tapping year.

5. **Tapping Experiment No. 14 (Ladder Tapping)**—This experiment was started in August 1944 to compare the double-three system with (a) double-three plus a half-circumference V cut at 8 feet from the ground tapped downwards with the aid of a ladder and (b) double-three plus a half-circumference V cut opened on virgin bark just above the tapping panel and tapped upwards. A number of trees was lost during a storm in June and the replications of the three treatments were reduced from 46 to 32. A statistical investigation confirmed the validity of the results on the latter basis and the yields were recalculated from the commencement of the experiment. A summary of yields expressed as a percentage of the control 2S/2,d/3,133% is given in Table III.

TABLE III

			2S/2+V/2 (ladder), d/3,200%			2S/2+V/2 (upwards), d/3,200%		
			Lower cuts	Upper cuts	Total	Lower cuts	Upper cuts	Total
August '44 to	July '45	..	87	56	143	80	56	136
	Aug. „	..	91	61	152	70	59	129
	Sept. „	..	92	62	154	61	68	129
	Oct. „	..	96	64	160	70	57	127
	Nov. „	..	100	73	173	77	63	140
	Dec. „	..	96	64	160	70	51	121

The increased yields of 43 and 36 per cent in the first tapping year are statistically significant, the significant difference for a (.05) probability test being 17 per cent. In the first tapping year the ladder cuts and upward cuts have depressed the yields of the normal cuts to the same extent, but in the first five months of the second tapping year there is a strong indication of the greater depressing effect from upward tapping.

6. **Budded Rubber Tapping Experiment No. 5, Dartonfield, Clones GL.1, AV. 256, PB. 25**—Trees planted in 1934 as budded stumps were taken into tapping in 1941. The experiment consists of 4 tapping systems in single-tree plots, randomised with 64 replications in each of the three monoclonal blocks. Yields for the first four years in pounds per tree per annum and the tapping system employed are shown in Table IV.

The general level of yields in 1944–45 was influenced by two factors: (a) the number of tappings was 10% lower than in the previous year, (b) an inadequate allowance for moisture content of the sample biscuits was made prior to 1944–45, the over estimate being approximately 10%.

Owing to a sharp increase of Brown Bast cases in clone GL.1 tapped at 100% intensity, the S/2,d/2 system was changed to S/4,d/2,50%, and the 2S/2,d/4 system to S/2,d/4,50% in September 1944. The high yield from the S/3,d/2 system is probably due to the fact that new panels were opened at the beginning of the season.

Clone AV.256 shows a marked decrease in the percentage yield on the 2S/2,d/3 system, whereas the level has been maintained in clone PB.25.

The total number of Brown Bast cases, shown in the final column of Table IV, indicates a very serious position in clone GL. 1. The high incidence of the disease first showed up in the third tapping year, and it is clear that 100% tapping intensity is too heavy for this clone after the second year. In this connection it should be noted that advices from Malaya have always been that GL.1 should be tapped at 67% intensity, and that the Research Scheme has advised the adoption of 67% tapping after the first year. It is, however, disquieting that the proportion of Brown Bast cases is very high even in the plots which have been tapped at 67% intensity from the start of the experiment. So far reports from estates have not indicated a high proportion of B.B. in this clone, and it remains to be seen whether the area at Dartonfield will prove exceptional. In the meantime caution is advised in the use of GL. 1 in planting programmes.

TABLE IV

Yield in lbs. per tree per year as percentages of S/2, d/2, 100%

Clone	Tapping System	1941—42		1942—43		1943—44		1944—45		Total Brown Bast Trees 1942—45
		Yield	%	Yield	%	Yield	%	Yield	%	
GL. 1	S/2, d/2, 100%	5.47	100	6.57	100	8.26	100	14.28	—	43
	S/3, d/2, 67%	4.44	81	5.37	82	6.84	83	9.29	—	17
	S/2, d/3, 67%	4.07	74	6.02	92	8.33	101	5.80	—	20
	2S/2, d/4, 100%	5.07	93	6.30	96	10.18	123	15.14	—	29
AV. 256	S/2, d/2, 100%	3.13	100	4.39	100	5.37	100	5.25	100	8
	S/3, d/2, 67%	2.40	77	3.39	77	4.22	79	4.20	80	1
	S/2, d/3, 67%	2.24	72	3.26	74	*8.93	166	6.23	119	16
	2S/2, d/4, 100%	3.39	108	4.96	113	6.73	125	5.31	101	12
PB. 25	S/2, d/2, 100%	3.70	100	5.56	100	6.30	100	4.97	100	6
	S/3, d/2, 67%	2.75	75	4.28	77	4.69	74	4.45	90	5
	S/2, d/3, 67%	2.66	72	4.12	74	10.26	163	7.65	154	10
	2S/2, d/4, 100%	3.50	95	6.00	108	7.61	121	5.95	120	7
GL. 1 excluding B. B. trees	S/2, d/2, 100%					9.15	100	6.62	—	
	S/3, d/2, 67%					7.14	78	9.85	—	
	S/2, d/3, 67%					8.41	92	7.10	—	
	2S/2, d/4, 100%					10.58	116	6.92	—	
Mean number of tappings on S/2, d/2.		135		138		150		134		

* Changed to 2S/2, d/3, 133%—March 1943.

† " " S/4, d/2, 50%

† " " S/2, d/4, 50%

SOILS DEPARTMENT

L. A. WHELAN

THE Soil Chemist was on duty until 30th December, when he left the Island on leave.

(1) **Fertiliser Rationing**—Allotments for 1946 were calculated on receipt of returns from estates. The quota is the same as in previous years except that Rubber planted in 1938 is classed as "mature" in 1946. 188 late returns were attended to for the 1945 issue and 948 for the 1946 issue.

(2) Experiments on Mature Rubber—

(a) **Dartonfield Experiment on Manuring Mature Rubber 1936.** Tapping was on the "double three" system throughout the year. The mean yields for the year in kilograms of dry rubber per plot of 20 trees on the basis of 1 tapping per month were :—

		O	N	NP	NK	NPK
Actual yield	..	4.71	5.93	5.25	5.56	5.96
Adjusted yield*	..	4.99	5.91	5.28	5.44	5.79
Adjusted yield as percentage of control	1945 {	..	118	106	109	116
	1944 {	..	115	109	117	115

*Standard error .197

Significant difference .57 (odds 19 : 1).

The manured plots N and NPK show significant increases over the control, but NP and NK show no significant increase. The results indicate that N alone has given the maximum yield and that P added to N has brought about a significant decrease in yield.

(b) **Cattle Grazing Experiment in Mature Rubber**—A small experiment was started in July to study the effects of grazing cattle under mature Rubber.

(3) Experiments on young Rubber—

(a) **No. 2 Manuring Experiment (Budded Rubber), Dartonfield 1938**—The 1945 girth measurements are reported in an article in the combined Quarterly Circular for 1945. Girth measurements taken in June at 4 feet above ground level showed a mean response to P of 2.8 inches for the 7 years of the experiment but no significant response to N or K. There has however been no response to any of the nutrients during the preceding 12 months. Owing to the retarding effect of tapping on growth, girth figures are of limited value at this stage but they indicate that phosphate should be applied in the early years of growth to give the maximum effect.

The number of tappable trees (18 ins. girth) irrespective of plot means in August 1944 is given below as a percentage of the total plot trees per treatment :—

O	N	P	K	NP	NK	PK	NPK	Compost
62	65	85	55	94	75	91	94	93

Trees were brought into tapping on the half spiral, alternate-day system in March and September 1944 and March 1945 on the basis of the mean girths of plots (17.5 ins.) and the girths of individual trees (18 ins.). The number of trees in tapping in March 1945 and the kilograms of dry Rubber obtained on the basis of one sample tapping per month over the period March 1944 to August 1945 for each treatment were :—

	O	N	P	K	NP	NK	PK	NPK	Compost
Trees	.. 34	30	61	27	82	42	69	83	74
Yield	.. 2.83	2.16	9.31	2.78	13.15	6.42	12.67	12.80	12.53

Observations made in January confirmed those of last year that NP and NPK mixtures appear to retard wintering.

(b) **No. 15 Manuring Experiment (Phosphate placement), Hedigalla 1943.**—Girth measurements at 3 feet made 2 years after planting budded stumps showed no difference between dibbling in saphos phosphate round the plants and concentrating it in balls at 6 ins. depth.

(c) **No. 16 Manuring Experiment (Phosphate level), Hedigalla 1944.**—Girth measurements made 14 months after planting budded stumps showed a significant response of 1/4 inch to 9 ozs. saphos applied at planting but no significant responses to smaller doses.

(4) **Field trials with insecticides.**—Experiments were carried out on the control of the cockchafer grub (*Lepidiota pinguis*) in a nursery with 3 samples of proprietary insecticides. There were indications that the treatments were of value.

(5) **Storage test on fertilisers.**—A 160-lb sample of an ammonium nitrate, saphos phosphate, muriate of potash mixture stored in the rubber factory showed that packing in a gunny bag is unsuitable for this type of mixture in the wet low country.

In the Soils Department there was an increase in enquiries of a general nature and in those dealing with fertiliser rationing.

General ..	.. 102
Fertiliser rationing ..	.. 186

No visits were made to estates during the year.

Laboratory work.—Only 1 sample each of soil, fertiliser and Rubber leaves was received for analysis from estates during the year. Soil samples (40) and leaf samples (30) from manuring experiments on Dartonfield were examined.

SMALLHOLDINGS DEPARTMENT

W. I. PIERIS

GENERALLY speaking the year has been a favourable one to the Rubber smallholder with the price of rubber at one rupee per pound (except during the first quarter when it was -/82 cents) and the weather unusually dry which permitted of maximum tapping. The strain of heavy tapping throughout the war years, however, has begun to manifest itself in a good many cases, and a number of owners are contemplating replanting their holdings in 1946 and subsequent years unless the market shows a markedly downward tendency.

The Department maintained its usual advisory services to Rubber small owners throughout the year and, from April to December, also supervised the tapping on peasant and middle-class budded Rubber plantations which have been opened under the New Rubber Planting Scheme.

Visits.—A total of 32 visits of inspection were made to the seven Instructors' ranges, approximately averaging 4 visits per range for the year. Advisory visits to small estates were made at the request of owners. The Matugama range was inspected by the Smallholdings Committee in August.

Staff.—Two new Instructors, Messrs. T. B. Dissanayake and W. V. Fernando, were appointed in March and trained for the vacancies in the Kelani Valley and Galle ranges. They took charge of these ranges on April 23rd, but Mr. Fernando resigned on June 30th. Mr. J. D. S. Wickremeratne was appointed in July in his place and, after training, was assigned in charge of the Kegalla range as from July 30th, while Mr. D. R. Ranwala, Rubber Instructor, Kegalla, was transferred to the Galle range. The departure of two successive Instructors from the Galle range within 6 months caused a temporary set-back to the work in that range, especially in view of the New Planting work entailed, but lost ground was fully recovered by the end of the year.

Three out of the 7 instructors only possess bicycles for their travelling at present and it is felt that the possession by them of some form of motor vehicle would be a considerable asset to their work. Applications for loans from the Board for the purchase of second-hand motor cycles were made by two of these officers and they were informed that their applications will be considered on the completion of their year of probation. The position regarding tyres for Instructors' cars was fairly satisfactory.

Provision for the appointment of 3 additional Instructors in 1946 was made by the Board.

New Planting—Early in the year the Department was requested to supervise the tapping on Budded Rubber holdings which had been opened under the New Planting Scheme. Arrangements were made with the Land Commissioner for lists of tappable holdings to be forwarded periodically and the first list of 165 such tappable areas was received in March. Two further lists of 69 holdings were received subsequently, comprising a total of 234. All holdings in the lists received were allocated among the seven Rubber Instructors according to their situation and visited. Detailed instructions on the correct method of opening cuts, tapping, amount of bark to be consumed, prevention of panel diseases, etc., were given to each owner, and by way of demonstration up to 200 tappable trees (later reduced to 25) that had reached the required girth of 18" at 3 feet from the union, were marked and stencilled by the Instructor at each holding. Contact with owners was maintained by means of re-visits as often as possible. No previous instructions on tapping were found to have been given to owners, and a number had commenced tapping on under-girth trees while others were tapping their trees daily. The danger of these practices, especially to budded trees, was explained and a good many were weaned from these habits and their trees saved from ruin in the nick of time. Owing to the prevailing high rubber price, however, a certain number persisted in these methods and nothing but compulsory legislation is likely to answer in their case. The majority however, have welcomed the advice given them and are tending their budded plantations with appropriate care.

A total of 577 visits and re-visits were made to New Planted holdings by Instructors and 13,018 tappable trees were marked for demonstration. Of the 234 holdings in the lists received, 106 are being tapped alternate daily and other instructions followed, in 47 general instructions are being followed but daily tapping is resorted to, while the balance 81 are not being tapped yet as the tappable trees are insufficient to form a task. 59 holdings other than those contained in the lists were also visited at the direct request of their owners.

The supervision of tapping on New Planted areas was executed with special care and thoroughness in the expectation that it would form part of the Department's permanent functions. A communication was received from the Land Commissioner in December, however, that the arrangement was to be terminated.

A report on the condition of new planted holdings was submitted to the Acting Director by request.

Leaflet—A leaflet (No. S.H.4) on " Tapping Young Budded Trees " was written and issued both in English and Sinhalese. 3,500 English and 4,000 Sinhalese copies were printed and a copy was issued to the owner of every tappable New Planted and Re-planted holding visited.

Re-planting—There was hardly any re-planting among smallholders, only 3 holdings comprising 6 acres being lined by Instructors for this purpose. Replanting was not encouraged owing to the loss of rubber for the war effort resulting from the felling of trees capable of giving even a little latex. A total of 470 supervisory visits, however, were made to holdings previously replanted and 754 tappable trees were marked and stencilled for tapping. Assistance was rendered by Instructors in filling manure application forms for obtaining manure for replanted blocks, and in applying the manure when received.

The yield per tree per tapping at the demonstration replanted block at Baddegama (Clone PB. 86, planted in November 1938 and tapped since September 1943) was 26.29 gms for the 5 months August to December. 62 trees were tapped. No records were available from January to July owing to the absence of an Instructor. Tapping was commenced on the demonstration replanted blocks at Matugama (clones GL. 1 and BD. 5, planted June 1938), Galagedera (PB. 25, planted December 1938) and Ratnapura (TJ. 1, planted December 1938). All 7 demonstration replanted blocks were manured with cattle and compost manure and their annual girth measurements were taken. The average girth expansion per tree for the year varied from 1.53'' to 3.54'' in the 7 blocks.

Sheet-making and smokehouses—The improvement of the quality of smallholders' sheets, which is one of the primary aims of the Department, was pursued by means of sheet-making and rolling demonstrations, advisory visits and the construction and improvement of smokehouses. 43 private and 12 demonstration smokehouses of the type recommended for smallholders were started and 35 private and 9 demonstration ones completed. 42 houses were improved. 199 sheet-making and rolling demonstrations were given and 278 smokehouses and 7 curing sheds visited for advice. 86 wooden latex pans and 62 strainers were issued free to smallholders who are making good sheet and otherwise carrying out recommendations. 148 sq. ft. of mesh for strainers was sold. The rubber-making at the Hataraliyadde Co-operative Rubber Society was supervised by the Rubber Instructor, Katugastota, who paid 26 visits and tested the metrolac once a month. The Goorokoya Co-operative Rubber Society was also visited by him on two occasions for advice on sheet making.

The Rubber Commissioner's depots have served a very useful purpose in obtaining for smallholders a fair price for their rubber, and in distributing unadulterated acid. The intention to close down the depots in early 1946 was, therefore, noted with regret.

Urumiwela Allotments—Urumiwela Estate, Bulathkohupitiya, which has been acquired by Government and allocated to villagers in 2-acre allotments was visited in November at the request of the Land Officer, Kegalla, and a report submitted. Owing to losses of coagulum detected during transport to an estate factory 5 miles away, the allottees expressed dissatisfaction at the present arrangement and desired to have their own sheet factory and smokehouse. Advice on constructing suitable buildings and on replanting portions of the allotments was sought. It was observed that most of the prevailing ills were due to lack of adequate supervision. Apart from losses of coagulum during transport, adulteration of latex by allottees and unsatisfactory tapping and methods of handling the latex were observed. The metrolac was tested and its error determined. The importance of knowing this was stressed as payments to individual allottees, whose latex was bulked and converted into crepe, were based on the quantity of latex brought by each and its D.R.C. The equipment, present inadequate buildings and transport cart were unclean and needed thorough renovation. Advice on replanting and on new buildings was given. As in the case of previous reports sent to the same authorities, no acknowledgment of the report was received, but it is hoped that necessary action to improve conditions will be taken.

Food Production—Assistance in food production work was only called for from the Instructors at Katugastota and Kegalla. The former lined 1 allotment (70 acres) for contour drains and visited 5 allotments (249 acres) for advice. The latter supervised the planting of food crops on 56 market garden allotments in Kegalla town and issued free planting material and implements for the Assistant Government Agent.

Nurseries—One private and 7 demonstration nurseries were opened and an average of 3–4 demonstration nurseries were maintained in each range during the year for demonstrating budding. 29 budding demonstrations were given. 221 yards of budwood were issued to Instructors for budding nurseries, 2,531 nursery plants were budded and 620 budded plants sold to smallholders. The Handupelpola nursery was attacked by cockchafer grubs and various poison treatments were tried by the Soil Chemist on an experimental scale.

General—Other than demonstrations already mentioned, 184 upward tapping, 291 marking and tapping, 112 disease control, and 180 miscellaneous demonstrations were given by Instructors. 32 demonstration and 30 private compost pits opened. Inward correspondence was 658 and outward 707.

ESTATE DEPARTMENT

G. P. N. DE SILVA

Dartonfield Estate Acreage Statement

	A. R. P.
Rubber : mature areas ..	114·1·28
replanted areas ..	44·3·22
Buildings and roads ..	14·3·08
Scrub, etc. ..	2·2·19
Newly acquired land ..	2·1·22
Total ..	179·0·19

Rainfall—134·93 inches.

Rainfall was exceptionally low, being 63 inches less than in 1944 and 45 inches less than the 5-year average. A monthly summary is given below :—

	1944	1945	5-year average
January ..	4·58 ins.	2·93 ins.	4·62 ins.
February ..	14·20 „	0·57 „	6·96 „
March ..	9·70 „	16·77 „	10·55 „
April ..	13·14 „	6·88 „	13·20 „
May ..	49·39 „	14·52 „	31·33 „
June ..	15·60 „	20·93 „	17·97 „
July ..	8·01 „	6·66 „	9·87 „
August ..	9·45 „	5·01 „	12·93 „
September ..	28·02 „	9·07 „	16·53 „
October ..	21·59 „	29·10 „	25·46 „
November ..	19·64 „	15·56 „	19·67 „
December ..	4·40 „	6·93 „	11·13 „
	197·72 ins.	134·93 ins.	180·22 ins.

Crop—Crop for the year was 84,280 lbs. compared with 85,049 lbs. in 1944 and an estimate of 90,000 lbs. The reduction of crop amounting to 6·4% based on comparable acreages is attributed partly to the loss of the equivalent of 5 acres owing to storm damage and building sites, partly to an over estimate of yield from replanted areas, and partly to spells of very dry weather.

Yield records for individual fields are as follows :—

Field No.	Date of planting	Total crop lbs.	Acreage tapped	Yield per acre lbs.
1 ..	1910	16,964	28½	595·2
2 ..	1913	840	1	840·0
3 ..	1917	15,182	24	632·6
4 ..	1911	1,152	1½	768·0
5 ..	1934	5,868	7½	782·4
6 ..	1913	36,022	58½	615·8
7 ..	1936	3,867	8¾	441·9
8 ..	1938	4,121	13¾	299·7
9 ..	1939	264	¾	352·0
		84,280	144¼	584·3

Percentage of estimate harvested—93·6

Tapping—Tapping of the commercial areas was continued on the 2S/2,d/3 system. Bark consumption was approximately 5 ins. on each cut. Upward cuts were opened on otherwise worthless trees. Tapping of half the estate tasks, the Tapping Experiment and the Replanted Areas was stopped for 15 days from 1st February ; other areas were tapped without rest. Tapping of experimental areas was under the supervision of the Estate Superintendent. The Visiting Agent reported favourably on the standard of tapping.

Average daily intake per tapper was 5·9 lbs. compared with 6·4 lbs. in 1944. It should be noted that the averages include experimental and young areas. Average daily pay amounted to Re. 1·30.

Manufacture—A summary of the grades prepared during the year is given below :—

Grade		lbs.	Per cent.	Total
Smoked Sheet No. 1	..	31,767	37·69	
do No. 2	..	224	0·27	37·96
Latex Crepe No. 1	..	14,098	16·73	
do No. 2	..	3,770	4·47	
do No. 3	..	7,185	8·53	29·73
Scrap Crepe No. 1	..	18,284	21·69	
do No. 2	..	1,956	2·32	
do No. 3	..	2,657	3·15	27·16*
Latex	..	4,339	5·15	5·15

*Includes experimental samples.

Machinery—The Consulting Engineers, Messrs. H. W. Hammond & Co., inspected the machinery and equipment on 8th & 9th February. Their report was satisfactory except in respect of the engines. The 52 H.P. Ruston Hornsby Engine was out of commission at the time of the visit owing to a leaking oil cooler ; wear in the piston and liner of the 20 H.P. Gardner Engine was reported to be excessive.

The Ruston Engine was out of commission in January and again for 3 weeks in February. It was given an extensive overhaul in July—August when new pistons and liners etc., were fitted. There was a further breakdown in October owing to a damaged bearing. In all the engine was out of commission for about 4 months during the year.

New piston rings etc., were fitted to the Gardner Engine in June ; a new piston and liner have been indented for.

Water Supply—A new double-acting pump was installed at No. 2 factory well. A stand-by well was sunk near the Junior Staff Bungalows and a hand pump installed.

Buildings—Construction of the following buildings was completed during the year—

Carpenter's Shed,
Drying house for experimental samples,
Partitioning of experimental factory.

Construction of the following buildings was in progress at the end of the year, under the supervision of the Estate Superintendent :—

Chummary for Graduate Assistants
Quadruple Cottage for minor staff.

Line roofs were given a coating of tar.

Oidium—Wintering was very early and most of the trees had refoliated before Oidium appeared. A severe attack developed in mid-February, following light showers, and a few late wintering trees and clones were affected. Two rounds of sulphur dusting were carried out at the rate of 5 lbs. per acre. per application. Replanted blocks in which hand pollination was in progress were dusted 8 times. In general the new foliage at Dartonfield, as on other low-country estates, was the healthiest which had been seen for several years.

Phytophthora—Pod and leaf disease was extremely mild, and there was less trouble with bark rot than during the past few years.

Routine applications of water-soluble and water-proof disinfectants were made to the tapping cuts.

Wind damage etc.—A cyclonic storm in June resulted in a large number of trees being uprooted or so severely damaged that they had to be removed, mainly in the old seedling areas. A summary of trees lost from various causes during the year is given below :—

Wind damage	..	427
Building sites	..	34
Fomes lignosus	..	13
Fomes Noxious	..	2
Lightning	..	1
Total	..	477

Manuring—Ninety-eight acres were manured out of a total of 121½ acres due for manuring. The balance 22½ acres was manured early January 1946 owing to the late arrival of the 4th quarter quota. The dose was R.400 mixture at 200 lbs. per acre. Intensive tapping area, 11 acres was not manured. Immature and experimental areas were manured according to requirements.

Cover Crops—Supplying with *Desmodium ovalifolium* was continued.

Labour—Labour was adequate for tapping but there was a shortage of village labour for weeding and general work during the first 3 quarters of the year.

Details of labour on checkroll at the end of the year were as follows :—

				Residents	Non-residents
Ceylonese	..	..	..	14	87
Non-Ceylonese	..	..	..	52	—
Average daily out-turn	..	..	..	82	
do do pay	..	..	..	1/28	

(including Dearness Allowance)

Weeding—The eradication of grass, lopping of rubber seedlings and indigenous erect cover was done.

Forestry Area—The control of natural covers was carried out according to experimental requirements. Weeding of grass was completed.

Health—The health of the labour force was not satisfactory during the year. We had 2 epidemics of Influenza and a number of cases of Malaria during this period. Consequently the attendance of patients at the Dispensary was considerable.

Visiting Agent—The Visiting Agent, Mr. P.R. May, inspected the estates twice during the year and reported favourably on their condition.

NIVITIGALAKELE

Acreage Statement

Rubber : mature areas (1926—1935)	..	88½	acres
clearings (1939—1944)	..	46	„
nurseries	..	19½	„
Uncultivated	..	16	„
Total	..	169½	acres

Rainfall—119.93 inches (1944—185.28 inches).

Crop—Crop for the year was 62,965 lbs. compared with 66,382 lbs. in 1944. The older fields in commercial tapping continued to give high yields. The following is a summary of yield records for each field :—

Clearing		Acreage in tapping	Crop lbs.	Yield per acre lbs.
1926	Clearing	.. 12½	12,843	1,027·4
1927	do	.. 16½	18,237	1,122·3
1928	do	.. 31	19,413	626·2
1935	do	.. 25¾	11,798	458·2
1939	do	.. 3½	674	192·6
Total		.. 89	62,965	707·5

Tapping—In the intensive tapping area 20½ acres due to be replanted in S.W. season 1946, two high cuts were opened in addition to the two lower cuts from July 1st, thus increasing the tapping intensity from 200% to 400%. Other commercial tapping areas were tapped on the 2S/2,d/3 system. Test-tapping was on the S/2,d/2 system. Tapping was stopped on the 11th February and re-commenced on the 5th March (22 days). A statement of trees in commercial and test-tapping is given below:

Clearing		Test- tapping	Commercial tapping	Immature	Total
1926	Clearing	.. —	1,112	—	1,112
1927	do	.. 73	1,484	—	1,557
1928	do	.. 190	2,355	—	2,545
1935	do	.. 1,157	1,072	326	2,555
1939	do	.. 343	—	676	1,019
		1,763	6,023	1,002	8,788

Manufacture—Crop from commercially tapped areas was manufactured in the form of smoked sheet. Test-tapping samples were milled at Dartonfield and sold as crepe. The distribution of grades is as follows :—

Grade		lbs.	Per cent	Total
Smoked Sheet	No. 1	.. 40,315	64·03	73·54
do	No. 2	.. 4,638	7·36	
do	No. 3	.. 1,351	2·15	
Scrap Crepe	No. 1	.. 12,452	19·78	26·46
do	No. 2	.. 3,559	5·65	
do	No. 3	.. 656	1·03	

Machinery—The grooved and smooth sheeting mills were overhauled. A new 5 H.P. National Engine and Pump was installed.

Bark rot canker—A number of trees were affected by bark rot and tapping canker, but damage was not extensive. Disinfectants were regularly applied.

Oidium—Two full and 1 partial rounds of sulphur dusting were done in the mature areas. The 1940 area used for collection of pollen was dusted 7 times during February.

Wind damage etc.—Trees lost from various causes were as follows :—

Wind damage	.. 81
Ustulina zonata	.. 3
Fomes ligonsus	.. 1
Fomes Noxious	.. 4
Total	.. 89

Canker—A round of canker scraping was done.

Manuring—Mature areas (excluding the intensive tapping area) were manured partly with R.400 mixture at the rate of 200 lbs. per acre and partly with R.300 mixture at the rate of 150 lbs. per acre. Immature areas and nurseries were manured according to standard recommendations.

Immature Areas—Growth in the 1939—44 clearings was satisfactory but pruning of indigenous cover in the “ No burn ” clearings was behind schedule owing to scarcity of labour.

Contour trenches in the 1940 clearing were filled with earth to half their depth, as recommended in Advisory Circular No. 4.

Intensive Tapping Area—Lining for re-planting holes in this area is in progress, planting being on the contour on existing platforms. In order to obtain a uniform stand of 145 trees per acre the spacing of the holes is being varied according to the distance between platforms. The normal spacing is 15 feet with contours 20 feet apart, and the distance is altered if the platforms diverge or converge to a substantial extent.

Nurseries—Budwood nurseries were manured and pruned according to requirements.

Seedling Nurseries 1944—Approximately 40,000 seedlings were uprooted to make room for hand pollinated seedlings. The balance approximately 14,000 were thinned out, and given a dose of 1/2 oz. R.215 mixture per plant.

Labour—Labour for tapping was adequate except during the paddy harvests, but there was a shortage of weeding and other general workers during the 1st, 2nd and 3rd quarters.

Hedigalla Acreage Statement

		A.	R.	P.
Area No. 1	..	.. 17	2	32
do No. 2	..	.. 15	3	06
do No. 3	..	.. 13	3	01
Chena Clearing	1944	.. 7	0	00
do	1945	.. 11	0	00
do	1945	.. 7	3	00
		72	3	39

Acreage Planted

1943 Clearing	..	.. 12	acres
1944 do	..	.. 14	do
1945 do (planted)	..	.. 16*	do
1945 do (unplanted)	..	.. 9	do
Buildings & roads	..	.. 5	do
Boundary strips	..	.. 17	do
Total	..	73	acres

New Planting—An area of 16* acres was planted with budded stumps experimentally during November—December 1945. Holes 3' X 2½' X 2½' deep were cut at a spacing of 17' X 17' (rectangular planting). 12 acres were planted with 2 plants per hole. 4 acres were planted with 1 plant per hole.

Immature areas—Growth in the areas planted in 1943—44 is satisfactory.

Manuring—The young areas were manured according to programme.

Green Manure—Cuttings of *Desmodium ovalifolium* were planted out and are spreading well.

Buildings—Completed during the year :—

- 1 Conductor's Bungalow
- 1 Set Quadruple Cottages.

Cart Road—A start was made in September on the construction of the first $1\frac{1}{2}$ miles of the approach road from the Badureliya-Attaltota Government road, and good progress has been made. Completion of this section will bring the road close to the estate boundary.

Food Production

Areas under cultivation for food crops were as follows :—

DARTONFIELD	..	..	..	..	$\frac{1}{2}$	acre
NIVITIGALAKELE : 1944 Clearing	..	..	..	..	5	acres
HEDIGALLA : 1942, 1943 and 1944 Clearings	..	..	..	..	20	do
HEDIGALLA : 1945 Clearing	..	..	..	..	11	do

Crops harvested during the year :—

Paddy	..	..	..	$31\frac{3}{4}$	bushels
Sweet potatoes	..	..	..	117	lbs.
Manioc	..	..	..	3,201	do
Yams	..	..	..	115	do
Pine apples	..	..	..	833	

ADVISORY SERVICES, ETC.

Advisory correspondence was on approximately the same scale as in 1944 and presented no special features as regards subjects of enquiry.

An analysis of enquiries and advisory visits to estates is given below :—

	Enquiries	Estate visits
Chemical Department	71	2
Botanical and Mycological Department	215	33
Soils Department	289	—

Advice was given to several Government and Service departments.

Three advisory circulars and two supplements were issued. Particulars are given under the heading of publications.

MEETINGS, COMMITTEES, ETC.

The Director (or Acting Director) attended meetings of the Rubber Research Board, and served on the Experimental and Smallholdings Committees, and an ad hoc Committee appointed to consider tenders.

The Director is an (ex-officio) member of the Central Board of Agriculture : one meeting was attended on his behalf by the Acting Director and one by the temporary Botanist. The Soil Chemist served on the Fertiliser Rationing Committee in the absence of the Director.

The Director attended the Annual General meetings of the Planters' Association of Ceylon and the Kalutara Planters' Association. Other general meetings of the Kalutara Planters' Association were attended by the temporary Botanist.

CO-OPERATION WITH OTHER RESEARCH ASSOCIATIONS

News was received shortly after the Japanese collapse that the Director and the majority of the staff of the Rubber Research Institute of Malaya were safe and reasonably well. We wish them a speedy return to full health after their ordeal and express our sincere sympathy at the loss of six of their colleagues. The writer had the privilege of attending a meeting of the staff in London (11th January, 1946) followed by a reunion dinner, and was glad to hear that the Institute buildings and a large proportion of the records are intact. Information regarding the Institutes in the Netherlands East Indies is scanty, but we have to record with deep regret the loss of Dr. A. D'Angremond, Director of A.V.R.O.S. Proefstation. It may be hoped that the rehabilitation of the Institutes in Malaya and N.E.I. will be rapid, and that co-operation with the R.R.S. will become even closer than before.

The Director had consultations with the staff of the London Advisory Committee for Rubber Research (Ceylon & Malaya) while on leave, and visited the laboratories of the Research Association of British Rubber Manufacturers.

There was close co-operation with the Tea Research Institute in connection with Fertiliser Rationing.

PUBLICATIONS

Publications of the Research Scheme are issued without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of Rubber estates over 10 acres in extent, who apply for registration. Extra copies are supplied for the use of Assistants on large estates. Particulars of issues of publications are given below :—

	1944	1945
Estates and Agencies	916	935
Subscribers	54	44
Exchange List	56	57

Publications issued during the year were as follows :—

Report of the Work of the Rubber Research Board in 1944.

Combined Quarterly Circulars for 1944.

Combined 1st and 2nd Quarterly Circulars for 1945.

Advisory Circular	No. 17—2nd Supplement (March 1945)
do	No. 22—2nd Supplement (December 1944)
do	No. 23—Uniformity in Nomenclature of Clones and Clonal Seedlings (December 1944)
do	No. 24—The Treatment of Brown Bast (December 1944)
do	No. 25—Ground Covers (January 1945)
Special Circular	—Proposals for Future Development (January 1945)
S. H. Leaflet	No. 4—Tapping Young Budded Trees (March 1945)

(Sgd.) T. E. H. O'BRIEN,
Director

Research Laboratories,
Dartonfield, Agalawatta,
21st March, 1946.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA) FOR 1944

THE work of the Rubber Department of the Imperial Institute is directed by the London Advisory Committee for Rubber Research (Ceylon and Malaya) and reference was made in last year's Report to a Conference called by this Committee to consider whether plans for the production of rubber in Malaya should be based on pre-war methods of preparation and packing. During the year the Conference obtained the views of British and American manufacturers and consulted various technologists and planters with wide experience of large-scale rubber production. Discussions are still in progress, but definite conclusions are beginning to emerge. It is generally agreed that there are possibilities of improving methods of preparation and packing along specified lines. In addition, there is scope for the production of a number of specialities, the nature of which the Conference is defining. The technical information available, however, requires amplification before plans can be put into operation, so that pre-war methods must continue for a time while the details of the proposals are subjected to practical study with a view to making definite recommendations.

The Conference is also analysing the technical advantages and disadvantages of preparing and packing rubber in large-scale central factories instead of on individual estates. The establishment of these factories would, of course, involve political and commercial issues outside the scope of the Conference, which is only concerned to express an agreed opinion on the technical merits and demerits of the proposal. It is so far considered that a large-scale central factory would produce a more uniform and reliable product than individual estates, but the scale of operation would introduce technological difficulties which are now being carefully considered.

Experience with synthetic substitutes for natural rubber has shown that they have important merits and demerits not revealed by the type of test customarily applied to determine the general quality of natural rubber, and it is becoming doubtful whether pre-war testing methods used in the East were adequate to distinguish in a practical way between the quality of rubbers from different trees or prepared by different methods. Manufacturers have been compelled by recent circumstances to direct special attention to the development of tests to bring out important differences between the various types of material available to them during the war, and the staff of the Committee at the Imperial Institute has been studying the modifications required to enable the tests to be applied to natural rubber in the East.

The tests are being developed so as to be applicable to a few grams of material with a view to studying the quality of rubber from individual trees. They are also being studied statistically so that sources of error can be appreciated, and, if possible, eliminated and the size of significant differences determined so that accurate conclusions can be drawn regarding variations in the quality of rubber.

Before the war Ceylon produced less than 10 per cent of the world's output of natural rubber, but is now the principal source left to the Allied nations. For many years up to 1940 rubber was produced in such abundance that the lower grades of scrap were not worth collecting. Neither labour nor equipment is available in Ceylon to treat all these lower grades, much of which is therefore shipped to consuming countries in a wet and dirty condition. Arrangements were made with the Ministry of Supply during the year for the washing loss of representative samples to be determined in the Imperial Institute laboratories and the results used to grade the crude material. A careful check was also kept on the quality of the washed rubber. During 1944 nearly 200 samples were tested. In addition, a comprehensive study was made of the Ceylon and Ministry of Supply grading systems and their relation to the real quality of the rubber. The correlation was far from perfect, but a simple alternative system could not be suggested.

Since the loss of Malaya the Department has studied and advised on new botanical sources of rubber and its treatment on arrival in Great Britain. At first little was known about the behaviour of wild rubbers under modern conditions of manufacture and, as recorded in last year's Report, much spade work had to be done. Since then a considerable amount of technical information has been accumulated and experience gained. Wild rubber from Tropical Africa now enters fairly smoothly into the manufacture of a wide range of selected articles, and its value and limitations are generally recognised. The development work has accordingly largely ceased, but the routine control of quality and grading of supplies on behalf of the Ministry of Supply has naturally been maintained.

Towards the end of last year and during the early part of this year a member of the staff visited most of the important rubber factories in Great Britain to discuss the utilisation of wild rubber. The views expressed were summarised in a report considered at a special meeting of the Ministry of Supply and the Technical Panel of the Federation of British Rubber and Allied Manufacturers' Associations. The discussion was mostly concerned with the cleanliness of washed rubber. Wild rubber is usually wet and dirty when it arrives in Great Britain and has to be washed at Ministry of Supply depots before being passed to manufacturers. Even then a small quantity of sand and vegetable fibre is unavoidably left in the rubber, the amount depending upon the physical characteristics of the dirt and the rubber. The manufacturer has no means of knowing beforehand whether he is likely to receive relatively clean or dirty material and this affects the purpose for which the rubber is used. The questions had already been studied experimentally by the Imperial Institute staff, whose proposals for improved washing and for a grade of specially clean rubber were approved. The establishment of this grade was made practicable by a new inspection apparatus, devised and constructed at the Imperial Institute, using polarised light. By means of this apparatus the clean material can be selected with speed and accuracy. The apparatus may also be of value for inspecting and grading plantation rubber after the war.

In addition, arrangements were made for labelling consignments of washed rubber so that manufacturing staffs would know when the botanical source is likely to be responsible for vulcanising difficulties.

During the year the staff made 5,020 plasticity tests for grading purposes, examined 415 samples of washed rubber for sand and fibre and made 1,605 moisture determinations as a routine check on washing depots. They also carried out tests and advised the Ministry of Supply in connection with a few complaints from manufacturers.

The study of new rubber sources naturally tends to diminish as the war progresses, but, even so, a thorough examination has been required of samples from Cabinda, Ivory Coast, Madagascar and Nyasaland. In addition, a study has been made of the properties of Gold Coast rubber prepared with different coagulants. None of the samples exhibited unusual features and the Ministry of Supply has been advised of their commercial value. Altogether, about 140 samples of wild rubber have been the subject of special investigation in connection with points raised by the Ministry of Supply or the African Colonies.

The value of wild rubber is largely dependent upon its content of rubber hydrocarbon, which is usually determined by subtracting the percentage of non-rubbers from 100. This is not very accurate and, in the case of rubber from novel sources, may be misleading. A direct method has recently been devised in the U.S.A. and was applied at the Imperial Institute to a range of wild rubbers from different botanical sources. It was found that the difference method required amplification, after which the results agreed fairly well with those obtained by the direct method. Full particulars were published in the *India Rubber Journal*, Vol. 107 No. 4, 22nd July, 1944.

The *Landophia* spp. of vine are the source of an appreciable amount of good quality rubber which, unfortunately, is difficult to vulcanise satisfactorily under

modern conditions. Experiments at the Imperial Institute indicate that the difficulty is due in part to the absence of naturally occurring accessory accelerators of vulcanisation and partly to the inhibiting effect of impurities. The explanation is not complete, however, and other factors may be involved. Good results can be obtained by adding accessory vulcanising agents, but such an addition is not generally practicable in routine factory operations which have to be standardised to avoid confusion and cannot conveniently be altered to suit the particular type of rubber which happens to be passing through the factory. The best remedy is to blend *Landolphia* rubber with that from other sources and manufacturers are encouraged to blend as many types as possible.

The investigation necessitated a study of the behaviour of various types of rubber in tyre tread compounds. Remarkable differences were observed in the effect of carbon black which is mixed with rubber to increase toughness and resistance to abrasion. The effect is partly dependent upon the degree of vulcanisation, but other factors appear to play an important part which is worthy of further investigation because of possible repercussions on the suitability for tyres of post-war plantation rubber.

Before the war the U.S.S.R. developed new sources of rubber from indigenous species of dandelion, viz., *Taraxacum kok-saghyz* and *Taraxacum krim-saghyz*. After the loss of Eastern plantations, seeds were sent to various allied countries, including Great Britain, where they were distributed by the Royal Botanic Gardens, Kew, for experimental cultivation. The plants were harvested and submitted to the Imperial Institute to study methods of extracting the rubber and for a detailed examination of its quality. Plants grown in Egypt were also forwarded to the Institute for examination. Suitable methods of extraction were devised, using the rod mill referred to in last year's Report. The dry roots contained, on an average, up to 10 per cent. of rubber, which was found to be nearly as good as plantation rubber. The yield per acre is, however, much smaller than that of plantation rubber and the cost of production very much higher. In spite of the rubber shortage, labour and good agricultural land could not be spared in Great Britain to grow the crop on an extensive scale.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON & MALAYA) FOR 1945

GENERAL ADMINISTRATION

Committee and Staff—The Committee regret to report the resignation of Mr. J. L. Milne who has rendered valuable service for many years. Mr. Milne was the representative of the Rubber Growers' Association who have now nominated Mr. J. W. M. Kennedy as his successor. Mr. G. G. Balazs of the Goodyear Tyre and Rubber Co., Wolverhampton has returned to the U.S.A. Mr. L. H. Bennett, who has taken his place in the Co.'s laboratories, has been requested to join the Technical Sub-Committee so as to continue this useful link with American manufacturers.

The Committee and Technical Sub-Committee held two meetings during the year. There were also two meetings of the Conference on the Post-War Preparation and Packing of Rubber.

The meetings of the Committee and Technical Sub-Committee were attended by Dr. C. E. Ford, Geneticist to the Rubber Research Scheme, Ceylon and by Mr. M. W. Philpott, Chemist to the Rubber Research Scheme, Ceylon, whilst on leave Mr. T. E. H. O'Brien, Director of the Rubber Research Scheme, Ceylon was also on leave, but unable to attend the meetings owing to illness.

Mr. G. Martin, Superintendent of Rubber Investigations, was given permission to visit South Africa on behalf of the Ministry of Supply. The Japanese war came to an end while he was in transit and he was recalled by the Government.

Finance—The cost of the work carried out by the senior staff has again been shared between the Rubber Research Scheme, Ceylon and the Imperial Institute, who have agreed to continue this arrangement during 1946. It is then hoped that the Rubber Research Institute of Malaya will again become the main contributor and that Imperial Institute assistance will only be required for the provision of facilities and services, as in 1940. In addition to research, the staff have carried out much routine testing of wild rubber from Africa and of lower grades of scrap from Ceylon on behalf of the Ministry of Supply who have continued to make a financial contribution towards the cost. The supply of rubber from Malaya and the Netherland East Indies is expected to be unsatisfactory for some time, so that the routine work on behalf of the Ministry of Supply will probably have to be continued for at least another twelve months.

Rubber Research Institute of Malaya—Although the end of hostilities was not expected until 1946, plans for the resumption of research in Malaya were under active consideration by the London Advisory Committee throughout the year. Suggested arrangements were somewhat speculative owing to lack of information about the conditions which were likely to operate when Malaya was recovered. Even in September—a month after the Japanese surrender—it was necessary to face the possibility that few of the pre-war staff of the Rubber Research Institute would be able for a long time to resume work in Malaya and that the destruction of buildings and equipment, as well as the absence of funds, would add to the difficulties of the situation. The London Advisory Committee were glad to learn, therefore, that the Colonial Office proposed to make themselves temporarily responsible for development work and research on Rubber in Malaya, as part of the activities of the Department of Agriculture and that they were proposing to offer employment to a few scientists experienced in rubber research, who had not been taken prisoner by the Japanese.

These plans were not proceeded with as information was subsequently received that the Rubber Research Institute had been maintained as a going concern by the Japanese using Asiatic staff, and that the British Military Administration had agreed to take over financial responsibility for the continuation of the work and for the employment of a few essential Europeans. At the end of the year discussions were in progress between the Committee, the Director of Rubber Research Institute and the Colonial Office regarding the immediate position and future arrangements. The re-establishment of the Rubber Research Institute in Malaya and administration of staff now recuperating in Great Britain involves much work, for which the Imperial Institute has provided the Director, Mr. H. J. Page, with temporary facilities.

The Committee were relieved to learn the casualties amongst the Rubber Research Institute. European staff were less than expected, and that, apart from severe loss of weight, the survivors were for the most part in reasonable health. In 1940 the European staff numbered twenty-four, of whom five have died or been killed. The Committee are particularly concerned at the loss of W. S. Davey, B.Sc., F.I.R.I., who was a member of the staff of the Rubber Department of the Imperial Institute for twenty-three years until 1938, when he proceeded to Malaya as Head of the Chemical Division of the Rubber Research Institute.

Technical Conference on post-war developments—During the year the Conference appointed by the Committee to recommend post-war improvements in the preparation and packing of rubber concluded their discussions and submitted a report, which was approved by the Committee, who were fortunate in obtaining facilities at the Imperial Institute for quick publication and wide circulation. The manufacturers and trade organisations in Great Britain and U.S.A. who were consulted,

had no unusual suggestions to offer, but provided sound advice and useful information, which enabled the Conference to formulate the main lines along which developments should proceed.

RESEARCH IN LONDON

Continuous process of rubber preparation—Some of the suggestions made by the Conference await the resumption of research in Malaya. In one instance, however, the London staff was able to commence investigations before the final report was issued. Early in their deliberations the Conference agreed that attention should be given to the development of continuous methods of preparing rubber, substituting mechanical devices for hand labour which was expected to be scarce and expensive. Unfortunately, owing to casualties, the labour situation is even worse than was anticipated.

The staff appreciated that quick coagulation and drying were essential to a continuous process, and for a time they experimented in filtering and also in spray-drying flocculated latex which had been allowed to cream. The process did not promise to be a cheap one, but in parallel investigations, it was found that very thin films of ordinary rubber coagulum, which would be dried in 10 minutes at a reasonable temperature, were strong enough to withstand normal mechanical strains. There is no great difficulty in coagulating ammonia-preserved latex fairly quickly. The staff, therefore, devised a continuous method of preparing thin films of coagulum which could be washed and dried and wrapped into rolls at a speed which gave a rate of output comparable with that of sheeting batteries. The new process has the advantage that it can produce packed (but not wrapped) dry rubber without the hand labour required for coagulation, smoking and packing of sheet. A plant was erected to demonstrate the idea on a small scale and a larger plant is now being constructed. It should be appreciated that the process is only in the development stage, that fresh latex is more difficult than preserved latex to coagulate quickly and that the quality of the rubber obtained cannot be studied until the process has been tried in the East. It is hoped to arrange for this towards the end of 1946.

Improvements in rubber supplied to tyre manufacturers—The staff have, fortunately, been able to devote more time this year to long range investigations and have concentrated chiefly on the problem of producing rubber for tyres with enhanced advantages over synthetic substitutes.

Experience with natural rubber and synthetic substitutes shows that the life of a tyre depends upon a combination of mechanical properties and that a deficiency in any one direction will result in reduced service. For laboratory testing purposes it is necessary to analyse and separate the mechanical qualities which are ultimately responsible for a tyre's inevitable end. Tests for resistance to tear and to abrasion and the development of heat, together with the usual stress-strain relationships are, therefore, being used to compare the suitability of different natural rubbers for tyres. The tests referred to do not exhaust the range of properties which might be studied, but some regard must be paid to the complexity of the investigation and to the speed with which tentative conclusions can be reached.

There is no agreed method of carrying out these tests for research purposes, and it has been necessary to build upon the published experiences of manufacturers and to adapt their methods to the testing of small samples of rubber such as are yielded by individual trees.

The test for resistance to tear has not required the construction of elaborate apparatus, but has necessitated considerable attention to detail with a view to improving accuracy. The results obtained still have a large experimental error, common to all tests for resistance to tear. Experiments are in progress to reduce this error, but, in the meantime, a procedure has been evolved, which can be used for comparing different rubbers as long as the limitations of the test are taken into consideration.

Tests on resistance to abrasion are being made along standard lines with due regard to the importance of temperature control. The most outstanding difficulty, for which a remedy is not yet envisaged, is the misleading character of the results which the test sometimes gives when compared with road trials. The test is of value, however, for comparative purposes and has been found useful for indicating differences between samples of rubber.

The third test is connected with the development of heat in tyres and has required the careful construction of special apparatus to measure energy changes in rubber when quickly deformed. The sample under test is deformed by the blow of a pendulum hammer and rebound measured. Attempts are being made to measure the internal stress by means of the electrical impulses developed in a piezo-electric crystal and conveyed to a cathode ray oscillograph, along lines envisaged by the Research Association of British Rubber Manufacturers.

The development of testing methods and the examination of special samples of rubber have proceeded side by side, each experiment being planned in accordance with statistical principles so as to obtain reliable information about the significance of any differences observed.

The tests were first applied to the examination of a series of samples which were known to represent extremes in the plasticity of unvulcanised rubber yielded by different trees. Parallel investigations in the East showed that some trees continued to produce hard and others soft rubber and that the property could be transferred from mother trees to clones by bud grafting. Attempts were made both in Ceylon and London to gain an insight into the nature of the difference between hard and soft rubber by a study of the fundamental laws of plastic flow. It was shown in London that soft rubber produced by the tree was not identical with rubber plasticised on mixing rolls. It was evident, however, that the elucidation of all the factors involved and their relation to molecular structure would require far more time than could be spared. This aspect of the investigation was, therefore, discontinued in London. The statistical examination of the results of the mechanical tests on vulcanised tyre tread rubber, prepared from various samples of hard and soft rubber, indicated that there was no significant difference between them irrespective of whether the rubber was obtained from seedling trees or from clones. This was disappointing as it was hoped that differences in plasticity might be an indication of important differences in the rubber hydrocarbon, which would affect the mechanical properties of the vulcanised product and lead to the preparation of a superior type of rubber.

There happened to be available old samples of rubber, which a tyre manufacturer had graded according to vulcanising properties, and also miscellaneous samples prepared in the East in connection with various investigations there. These samples were tested along the same lines as the hard and soft rubbers. They displayed significant differences in the properties of the vulcanised products, the most important factors appearing to be rate of vulcanisation and the amount of natural non-rubber substances present. The tentative conclusion is that non-rubber impurities modify the course of vulcanisation and the mechanical properties of the vulcanised product and should therefore affect the service given by tyres. It is considered that future developments in the East should consist of (1) a search for trees which give rubber with extreme rates of vulcanisation and, (2) a study of the effect of different methods of purifying latex and, (3) of modifying the non-rubber substances by biological and chemical agencies.

Composition and quality of preserved latex—One of the problems to which the staff devoted much attention prior to the war was the quantitative distribution of non-rubber substances in latex. Certain of these substances were shown to be dissolved in the serum, and some were absorbed on the surface of the rubber particles; others were inside the particles. On keeping the latex for several years it was found that complex compounds both on the surface of, and inside the particles slowly decomposed yielding water-soluble acids which migrated into the serum and formed

ammonium salts which caused difficulties to manufacturers owing to their reaction with zinc oxide in compounded latex, the zinc oxide passing into solution and tending to coagulate the partly de-stabilised latex. As a result of this work the testing of latex for quality can now be put on a scientific basis, and manufacturers can easily determine whether or not a particular lot of latex is likely to be troublesome. In addition investigators in the East can study the possibility of preventing the adverse changes. The staff have shown already that one method of doing this is by using sodium pontachlorphenate as a preservative instead of ammonia.

The investigation was discontinued after the invasion of Malaya, but during this year has been renewed, an attack being made upon the distribution of phosphorus, which it is suspected is present in fresh latex in organic complexes which slowly decompose yielding phosphoric acid. This is one of the acids which is particularly effective in causing thickening when ammoniated latex is compounded with zinc oxide. The results are not yet conclusive, partly because the latex is now very old, and some of the phosphorus appears to have been precipitated as a fine sludge which may be mechanically trapped by the latex particles and, therefore, associated with them in an irregular manner. The investigation can be more reliably carried out using fresh supplies of latex when they become available.

A study of the distribution of potassium has also so far been inconclusive because of the difficulty of estimating small quantities accurately. The experience gained has been of value in preparing for a further attack on the problem during 1946. The distribution of ammonia in latex has also been studied; as expected part of the ammonia is in solution in the serum and part is attached to the surface of the rubber particles in amounts equivalent to surface fatty acids.

Preparation and properties of chemically pure rubber—The pre-war studies of nitrogen distribution in latex showed that the addition of a soap, such as potassium oleate, resulted in the replacement of proteins at the surface of the rubber particles by soap. This phenomenon has now been used to prepare chemically pure rubber by treating latex with soap, followed by repeated creaming with alginates to remove the protein and other substances in the serum and then extracting the dried rubber with alcohol to remove soap and other impurities. The rubber obtained was not quite chemically pure, but it could be separated by light petroleum into a soluble and an insoluble fraction, of which the insoluble fraction contained practically all the remaining impurities. The different fractions of purified rubber were of reasonable quality and only deteriorated rapidly when exposed to light. They gave good mechanical results when vulcanised in lightly-compounded mixings, the insoluble rubber being much stiffer after vulcanisation than the soluble. Both fractions gave very poor results when loaded with carbon black and vulcanised (tyre tread type compound) and appeared to be almost identical in mechanical properties. It is well known that carbon black will reinforce even badly deteriorated commercial rubber and it was thought that the remarkable results given by pure rubber might be due to accidental circumstances. The experiment has been repeated several times with different operators and the same type of result obtained. The phenomenon is of great interest as it suggests, *inter alia*, that purified rubber can undergo a type of change which prevents reinforcement, or that raw rubber accessory substances are essential. In either case the possibility is opened up of changing the rubber or accessory substances so as to obtain superior instead of inferior reinforcement and of marketing an improved type of rubber for use in tyres.

Softened rubber—When rubber production in Malaya reaches equilibrium there should be a market for special types, amongst which softened rubber is of great potential importance. Previous work in Malaya showed that rubber could be softened by adding to latex small quantities of proprietary "peptising" agents or some accelerators of vulcanisation. It has since been shown that the effect is due to a temporary acceleration of oxidation of the rubber. "Peptised" rubber

kept in London throughout the war shows no signs of further softening. It has since been found that some of the proprietary antioxidants, which are added to rubber to retard deterioration of vulcanised rubber, can accelerate the oxidation of unvulcanised rubber and so act as "peptising" agents. The efficiency of some of them can be increased by a preliminary treatment with oxygen. One of the substances which has been used during the war to "peptise" rubber in Ceylon is mercaptobenzthiazole, which thus accelerates oxidation in unvulcanised rubber, retards oxidation in vulcanised rubber: besides acting as an accelerator of vulcanisation which confers useful mechanical properties on the vulcanised product. The oxidation effects are associated with certain types of chemical groups, but conditions largely determine in which direction the reaction will proceed. The staff have shown that the vulcanisation effect of mercaptobenzthiazole can be markedly dependent on the naturally occurring non-rubber impurities in rubber. For example, its effect on good quality Landolphia rubber is much less quantitatively than on Hevea rubber, which is identical as far as its rubber hydrocarbon is concerned. These results confirm that the non-rubber serum substances produce a series of effects, which are of importance in connection with the service given by tyres.

Wild rubber—The staff have continued to test and grade washed African during the war, but the routine work has required a fair amount of attention from the Senior Staff. An interesting investigation on Funtumia rubber was carried out in association with the Dunlop Rubber Company. The staff had found that Funtumia latex, coagulated with formaldehyde and vulcanised in a lightly compounded mix, gave a much stronger and tougher rubber than latex coagulated by boiling. Funtumia rubber was regarded as unsuitable for tyres and the possibility arose that coagulation with formaldehyde might get over the difficulty. Both the Dunlop Rubber Company and the staff agreed, after further examination, that the remarkable effect of coagulating with formaldehyde was not carried over to tyre tread compounds.

(Signed) P. J. BURGESS
Chairman

(Signed) G. MARTIN
Superintendent of Rubber Investigations

(Signed) R. WALKER
Acting Secretary

April, 1946.

RUBBER RESEARCH SCHEME (CEYLON)

AUDITOR GENERAL'S REPORT FOR 1945

Audit Office,
Colombo, 27th Sept., 1946.

The Chairman,
Board of Management,
Rubber Research Scheme,
Peradeniya.

The accounts of the Rubber Research Scheme (Ceylon) for the year ended December 31, 1945, were audited under my direction. The financial statements—

- (a) Dartonfield Estate Working Account ;
- (b) Nivitigalakele Experiment Station Working Account ;
- (c) Revenue Account, Capital Account and General Balance Sheet ; and
- (d) Provident Fund Working Account ;

were compared with the books and accounts and found to agree. The statements are returned herewith duly certified.

I—INCOME

2. The total income for the year amounted to Rs. 345,506/-. It fell short of the estimate by Rs. 18,697/- and was less than the income of the previous year by Rs. 29,884/-.

3. The following is a comparison between the estimate and the actual income under the different accounts; short notes of reasons for the excess or deficit are given under “ Remarks ”:—

Income for 1945					
	Estimate	Actual	Excess	Deficit	Remarks
	Rs.	Rs.	Rs.	Rs.	
1 Cess Collections ..	280,000	263,263	—	16,737	Over-estimate
2. Interest ..	18,000	17,781	—	219	—
3. Sale of Publications	750	836	86	—	—
4. Profit from Dartonfield ..	31,450	29,767	—	1,683	Over-estimate of crop.
5. Profit from Nivitigalakele ..	32,453	29,297	—	3,156	Over-estimate of crop and smaller sales of budwood and budded stumps.
6. Sundry Receipts ..	1,550	4,562	3,012	—	Rent of Bungalow at Dartonfield and profit from sale of vulcanised products not estimated for.
	Rs. 364,203	345,506	3,098	21,795	

4. **Profit from Dartonfield Estate**—The profit for the year under review was Rs. 29,767/- as against Rs. 40,733/- in the previous year.

5. **Profit from Nivitigalakele Experiment Station**—The working of the experiment station for the year under review showed a profit of Rs. 29,296/- as compared with Rs. 35,592/- for the previous year.

II—EXPENDITURE

6. **Revenue Expenditure**—The total expenditure on revenue account exclusive of the amounts allowed for Depreciation of fixed assets, and Audit Fee Reserve amounted to Rs. 324,702/- as compared with Rs. 298,682/- for the previous year. The details of this expenditure are fully set forth in the Revenue Account. The whole of this expenditure was checked with supporting vouchers and accounts.

7. **Capital Expenditure**—The expenditure incurred on fixed capital assets during the year amounted to Rs. 51,166/- as compared with Rs. 28,358/- for the previous year. The details of this expenditure are shown in the Capital Account.

8. A comparison between the approved estimates and the expenditure incurred during the year is shown in statement “ A ” attached. The reasons for the major variations between the estimates and the actual expenditure as furnished by the Director, are shown against the respective items in the statements.

III—CAPITAL ACCOUNT

9. The total expenditure on Capital Account at 31-12-44 was Rs. 814,420. During the year under review, Capital Expenditure amounted to Rs. 51,166, bringing the total capital cost at 31-12-45 to Rs. 865,586/-.

IV—BALANCE SHEET

(a) Liabilities

10. **Creditors Rs. 14,963**—Of this amount a sum of Rs. 14,523/- represents the amount due to creditors for goods purchased or services rendered during the year and Rs. 440/- represents subscriptions for 1946 publications, received in advance.

11. **Passage Fund Reserve Rs. 11,544**—The balance on December 31, 1944, was Rs. 15,488 and a sum of Rs. 5,064/- was transferred to this fund during the year. A sum of Rs. 9,008/- was utilised during the year in connection with the travelling performed by the Director to England by air and by two other members of the senior staff by sea. This reduced the total to the credit of the Fund to Rs. 11,544/-

12. **Depreciation Reserve Rs. 194,951**—This sum represents the amount set apart for the depreciation of the fixed assets of the Scheme. The amount transferred from Revenue to this account during the year was Rs. 17,873/- made up as follows :—

DARTONFIELD—

Buildings at $3\frac{1}{2}\%$ on Rs. 179,812/75	..	Rs.	6,293.45
Furniture, fittings and office equipment at $7\frac{1}{2}\%$ on Rs. 22,835/-	..	..	1,712.62
Water and Power Supply at $7\frac{1}{2}\%$ on Rs. 25,952/20	..	..	1,946.41
Machinery and tools at $7\frac{1}{2}\%$ on Rs. 57,913/11	..	..	4,343.48
Accumulators at 20% on Rs. 3,742/58	..	..	748.52

NIVITIGALAKELE—

Buildings at $3\frac{1}{2}\%$ on Rs. 35,488/48	..	..	1,242.09
Furniture, fittings and office equipment at $7\frac{1}{2}\%$ on Rs. 2,686/51	..	..	201.48
Water and Power supply at $7\frac{1}{2}\%$ on Rs. 3,868/96	..	..	290.17
Machinery and tools at $7\frac{1}{2}\%$ on Rs. 222/98	..	..	16.72

HEDIGALLA—

Buildings at $3\frac{1}{2}\%$ on Rs. 8,017/35	..	..	280.61
Furniture and fixed equipment at $7\frac{1}{2}\%$ on Rs. 400/50	..	..	30.04
Water and Power Supply at $7\frac{1}{2}\%$ on Rs. 149/50	..	..	11.21
Laboratory apparatus at $7\frac{1}{2}\%$ on Rs. 10,080/29	..	..	756.02

Rs. 17,872.82

13. **Provident Fund Reserve Rs. 145,676**—The balance to the credit of the Fund at the end of 1944, was Rs. 125,684/- and additions during the year under review amounted to Rs. 28,218/-. A sum of Rs. 8,226/- was paid out to officers who retired during the year.

14. **Medical Fund Rs. 5,565**—The balance to the credit of this fund at the end of 1944, was Rs. 3,401/-, and additions during the year under review amounted to Rs. 3,485/-. A sum of Rs. 1,321/- was paid out to the officers during the year.

15. **Audit Fee Reserve Rs. 1,344**—The amount to the credit of this account at the beginning of the year was Rs. 1,094 and that provided for the year 1945 was Rs. 850/-. Payments during the year in respect of service for 1944 amounted to Rs. 600/-.

16. **Reserve for stabilisation of Income Rs. 202,281/-** · The Reserve as at 31-12-44 was Rs. 170,018/- and the amount transferred to it in 1945 was Rs. 32,263/.

17. **Surplus Account Rs. 222,037**—The surplus at the beginning of the year was Rs. 303,385/-. To this was added a sum of Rs. 2,081/- being excess of income over expenditure during the year. After deducting Rs. 51,166/- and Rs. 32,263/- on account of contribution to Capital Outlay in 1945 and amount transferred to Reserve for Stabilisation of Income respectively, the balance in the Surplus Account at 31st December, 1945, was Rs. 222,037/-.

(b) Assets

18. **Debtors Rs. 61,792**—This represents cess collections for December, 1945, amounting to Rs. 28,389/-, and sundries amounting to Rs. 33,403/- which were outstanding at 31st December, 1945. The former has since been received in full.

19. **Advance Accounts Rs. 8,487**—Of this amount a sum of Rs. 7,922/- represents advances to the London Advisory Committee. The advances to the Superintendent of Dartonfield, Nivitigalakele, Hedigalla and Small-holdings Propaganda Officer were for Sundry expenses and the amounts shown are the balances with them at 31-12-45. The amount shown against the Postmaster-General represents the sum deposited with him in respect of trunk call and other telephone services.

20. **Accrued Interest on Investments Rs. 5,252**—This sum represents the amount of interest accrued for the year on the investments, but not received during the year. This has since been recovered.

21. **Payments in advance Rs. 2,032**—This represents certain expenditure incurred in respect of the year 1946 during 1945.

22. **Stocks Rs. 15,178**—The balances of the estate and rubber chemical stocks at the end of the year were Rs. 10,780/- and Rs. 4,398/- respectively. The balance of the estate stock was made up as follows :—

DARTONFIELD—

Rice and provisions	..	..	..	Rs.	777.75
Stores	..	..	..	..	2,286.48
Materials used for latex export	..	..	..	..	2,348.62
Preserved latex	...	..	..	..	4,830.00
Crumb Rubber	..	..	...	..	399.73

NIVITIGALAKELE—

Rice and provisions	..	..	..	..	137.32
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Rs. 10,779.90

These balances at the end of the year were not verified, but a test verification of the stock in hand at Dartonfield on 10th August, 1946, was made during the audit inspection with satisfactory results.

23. **Loans to Officers Rs. 136**—This sum represents the balance outstanding from Officers in respect of loans for purchase of transport. The loans are being regularly repaid with interest in instalments.

24. **Loan to Hataraliyadda Co-operative Society Rs. 1,900**—Of the sum of Rs. 2,400/- outstanding at the beginning of the year a sum of Rs. 500/- was repaid during the year.

25. **Investments in Ceylon Government Loans Rs. 570,000**—Details of this amount are shown in the Balance Sheet in terms of face value. The certificates in support of the investments were seen.

26. **Cash Balances Rs. 133,585**—Details of this figure are shown in the Balance Sheet. The Pass Books in respect of the Savings Bank Accounts were seen. The Fixed Deposit Receipt for Rs. 30,000/- was not available at the audit inspection in August, 1946, as the amount had been transferred to current account. The balances in current accounts Nos. 1 and 2 were verified by reference to Bank Certificates and Reconciliation Statements. The balance of cash in hand at December 31, 1945, was not verified, but a surprise verification of the cash in hand was made on 7th August, 1946.

V—General

27. **Travelling Allowance to the Superintendent of Estates**—The Superintendent of Estates draws a Travelling Allowance of Rs. 80/- per mensem in respect of travelling done in supervising Nivitigalakele and Hedigalla Estates. On inquiry I was informed that there were no special conditions attached to the allowance and that no certificate of the Director was necessary in support of it. I then requested the Director to specify conditions necessary for the payment of the allowance and suggested that payment be made on the usual Government travelling allowance form. I also suggested that the allowance should be subject to a monthly minimum mileage with provision for a proportionate reduction of the allowance when the required mileage was not performed in full. The Director, however, considered that it was more satisfactory to make payment at casual rates according to the distances travelled each month and placed the matter before the Board of Management which decided that the allowance of Rs. 80/- be paid irrespective of mileage, to cover maintenance and running costs.

28. The accounts were received quarterly and audited in this office. The office of the Scheme at Dartonfield Estate was visited once in respect of the accounts for the year under review and the books and accounts kept were checked and the cash in hand verified.

(Sgd.) E. ALLEN SMITH

Auditor General

ESTIMATES FOR 1946

(Adopted by the Board, October 29th, 1945)

INCOME

1. Cess Collections ..	..	..	..	Rs.	280,000
2. Interest ..	..	..	..	„	18,500
3. Sale of Publications	..	..	..	„	750
4. Profit from Dartonfield	..	..	..	„	27,537
5. Profit from Nivitigalakele	..	..	..	„	22,110
6. Sundry Receipts ..	..	..	..	„	1,500
					Rs. 350,397

REVENUE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1945

Rs. 345,505 77

RUBBER RESEARCH SCHEME (CEYLON)

DARTONFIELD ESTATE

WORKING ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1945

Dr.		Rs.	Cts.			Rs.	Cr. Cts.
TO EXPENDITURE :				BY SALES :			
General Charges	.. Rs.	19,471.99		Manufactured rubber (84,280 lbs.) ..	.. Rs.	78,877.53	
Upkeep, Manufacture and Distribution	.. "	30,536.52		Preserved Latex	.. "	41,777.58	
.. Planting Food Crops	.. Rs.	78.64	50,008 51	.. SUNDRY RECEIPTS :			
Less Proceeds from sale of foodstuffs	.. "	.60		Creping charges on outside rubber ..	.. Rs.	42.50	
.. PRESERVED LATEX :			78 04	Profit from Carting Account	.. "	63.15	
Value of Latex	.. Rs.	37,879.07					105 65
Incidental Expenses	.. "	3,028.09					
.. Balance transferred to Revenue Account ..	..		40,907 16				
			29,767 05				
		Rs.	120,760 76			Rs.	120,760 76

NIVITIGALAKELE EXPERIMENT STATION

WORKING ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1945

Dr.		Rs.	Cts.			Rs.	Cr. Cts.
TO EXPENDITURE :				BY SALE OF PRODUCE :			
General Charges	.. Rs.	11,246.69		Rubber (62,965 lbs.)	.. Rs.	58,860.41	
Upkeep, Manufacture and Distribution	.. "	15,089.70		.. Planting Material	..	3,299.29	
.. Upkeep of Nurseries			26,336 39	.. 100 Albizzia trees	..	500.00	
.. Handling and Distribution of Budwood and Budded Stumps			5,989 81				62,659 70
.. Planting Food Crops	.. Rs.	99.67	994 48				
Less proceeds from sale of foodstuffs	.. "	57.10					
.. Balance Transferred to Revenue Account ..	..		42 57				
			29,296 45				
		Rs.	62,659 70			Rs.	62,659 70

CAPITAL ACCOUNT AS AT 31ST DECEMBER, 1945

GENERAL BALANCE SHEET AS AT 31ST DECEMBER, 1945

The Balance Sheet and accompanying Statements of Account have been audited under my direction. I have obtained all information and explanations that I require and I certify that in my opinion the Balance Sheet represents a true and correct position of the finances of the Rubber Research Scheme.

(Sgd.) E. ALLEN SMITH,
Auditor General

WORKING ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1945

STATEMENT OF EXCESSES AND SAVINGS ON VOTES

Head of Estimates	ACCOUNT	Expenditure				Savings	
		Estimate Rs. C.	Capital Rs. C.	Revenue Rs. C.	Excess Rs. C.		
1.	ADMINISTRATION OF THE BOARD :						
	Travelling expenses of Members ..	3,000 00		3,053 70	53 70		
2. A—F.	Emoluments of Senior Scientific Staff ..	82,900 00		83,379 10	479 10		Allowance to Act. Director ; resignation of Botanist in November.
3. A—E.	Emoluments of Junior Scientific Staff ..	18,016 00		16,491 30		1,524 70	2nd Chemical Laboratory Assistant not appointed, and changes in staff.
4.	LIBRARY AND PUBLICATIONS :						
A.	Library ..	1,500 00		1,076 53		423 47	Binding of periodicals not under- taken.
B.	Publications ..	2,500 00		4,008 00	1,508 00		Increased printing charges and extra publications.
5.	SMALLHOLDINGS WORK :						
A—B.	Emoluments of Staff ..	22,950 00		21,053 67		1,896 33	Changes in staff.
C—D.	Travelling and General Expenses ..	12,312 00		10,308 54		2,003 46	do
6.	LABORATORY :						
A.	Equipment & Working Expenses ..	20,500 00	4,767 95	4,368 89		11,363 16	Special equipment not fully paid for.
B.	Furniture Replacements ..	50 00		30 64		19 36	
7.	FIELD AND FACTORY EXPERIMENTS :						
A.	Field Experiments ..	12,484 00		10,831 70		1,652 30	Less expenditure on seed gardens.
B.	Factory Experiments ..	6,069 00		1,186 77		4,882 23	Over estimate and less experiments undertaken.
8.	OFFICE :						
A—C.	Emoluments of office Staff ..	14,510 00		14,515 33	5 33		
D.	Stationery and Office Equipment ..	4,500 00		2,851 00		1,649 00	Economies.
E.	Postages and Telegrams ..	2,000 00		1,731 94		268 06	Economies.
F.	Advertising ..	300 00		960 76	660 76		More vacancies advertised.
G.	Telephone ..	1,000 00		995 00		5 00	
H.	Audit ..	850 00		850 00			
9.	TRAVELLING EXPENSES OF STAFF ..	7,000 00		6,070 45		929 55	Less travelling as 2 officers on leave.
10.	MAINTENANCE OF BUILDINGS, WATER AND POWER SUPPLY :						
A.	Laboratories and Offices ..	250 00		143 76		106 24	Less work undertaken.
B.	Bungalows ..	1,750 00		3,366 03	1,616 03		Work postponed in earlier years undertaken.
C.	Water and Power Supply ..	1,500 00		2,705 66	1,205 66		Unexpected repairs to motors and batteries.
D.	Bungalow Furniture Replacements ..	200 00		321 23	121 23		Underestimate.
11.	MISCELLANEOUS ITEMS SHARED WITH ESTATE						
A.	Dartonfield General Charges ..	16,358 00		19,471 99	3,113 99		Increased dearness allowance.
B.	Nivitigalakele General ..	10,342 00		11,246 68	904 68		do
C.	Hedigalla General Charges ..	5,980 00		7,090 68	1,110 68		do and arrears of ground rent.
D.	Upkeep of Roads and Grounds ..	844 00		833 44		10 56	
E.	Factory Upkeep ..	3,167 00		3,825 45	658 45		Unexpected repairs to Ruston engine.
F.	Power Supply ..	6,683 00		4,800 29		1,882 71	2 engines out of commission for about 4 months.
12.	CONTINGENCIES :						
A.	Contribution to London Advisory Committee ..	18,500 00		21,742 21	3,242 21		Basis of contribution increased
B.	General Charges ..	1,000 00		962 11	37 89		
C.	Insurance Charges ..	3,850 00		3,857 17	7 17		
D.	Staff Provident Fund ..	18,000 00		16,511 56		1,488 44	Changes in staff.
E.	Passages ..	5,000 00		5,000 00			
F.	Entertainment Allowance ..	150 00		112 50		37 50	
G.	War Allowance to Staff ..	31,600 00		35,525 13	3,925 13		Higher rate of allowance paid.
H.	Contribution to Medical Fund ..	1,950 00		1,930 00		20 00	
13.	DEPRECIATION ..	18,400 00		17,872 82		527 18	Over-estimate.
14.	PLANTING FOOD CROPS—HEDIGALLA	2,300 00		2,342 49	42 49		
15.	CAPITAL ACCOUNT :						
A.	Upkeep of Dartonfield Immature Areas ..	1,680 00	1,497 34			182 66	
B.	Upkeep of Nivitigalakele Immature Areas ..	3,467 00	2,799 96			667 04	Less work undertaken.
C.	Upkeep of Hedigalla Immature Areas ..	3,192 00	2,968 21			223 79	do
D.	Planting 20 acres Hedigalla (1945 Clearing) ..	6,805 00	5,613 14			1,191 86	Smaller area planted.
E.	Drying House (Dartonfield) ..	5,000 00	3,179 68			1,820 32	Work not completed.
F.	Alterations in Experimental Factory ..	3,500 00	2,500 38			999 62	Work not completed.
G.	School and Creche (Dartonfield) ..	12,000 00	150 00			11,850 00	do
H.	Hedigalla Cart Road ..	45,000 00	4,844 08			40,155 92	Work not completed.
I.	Furniture and Office Equipment ..	268 00	1,415 50		1,147 50		Furniture for new entrants.
J.	Water and Power Scheme (Darton- field) ..	1,500 00	1,287 42			212 58	Over-estimate.
K.	Quadruple Cottage for Peons ..	4,000 00	1,547 94			2,452 06	Work not completed.
L.	Replanting part of Nivitigalakele budwood nurseries ..	1,957 00	40 15			1,916 85	do
M.	Water and Power Scheme (Niviti- galakele) ..	4,300 00	3,574 16			725 84	Smaller engine purchased.
N.	Additional Servants' Latrine for Dartonfield Junior Staff Bungalows ..	100 00	—			100 00	Work not undertaken.
O.	Dartonfield Carpenter's Shed ..	2,144 00	2,025 79			118 21	Work not completed.
P.	Hedigalla Conductor's Bungalow ..	3,135 00	2,592 14			542 86	Over-estimate.
Q.	Hedigalla Quadruple Cottages ..	2,116 00	3,980 29		1,864 29		Change of specification, etc.
R.	Chummary for Research Assistants ..	—	6,122 75		6,122 75		Expenditure approved but no vote taken.
S.	Alterations to Motor Garage ..	400 00	—			400 00	Work not undertaken.
T.	Latrine to Conductor's Bungalow ..	259 00	259 15		15		

REVENUE EXPENDITURE

						Rs.
1. ADMINISTRATION OF THE BOARD :						
Travelling Expenses of Members	..	..	..	..	..	3,000
2. PERSONAL EMOLUMENTS :						
Senior Scientific Staff	..	..	Rs.	104,525		
Junior Scientific Staff :	..	..	„	23,155		127,680
3. LIBRARY AND PUBLICATIONS :						
Library	..	..	„	1,500		
Publications	..	..	„	2,500		4,000
4. SMALLHOLDINGS WORK :						
Salaries and Allowances	..	..	„	25,802		
Travelling and General Expenses	..	..	„	15,474		41,276
5. LABORATORY :						
Equipment and Working Expenses	..	..	Rs.	6,000		
Furniture Replacements	..	..	„	50		6,050
6. FIELD AND FACTORY EXPERIMENTS :						
Field Experiments	..	..	Rs.	10,215		
Factory Experiments	..	..	„	6,471		
Budding Instruction	..	..	„	—		16,686
7. OFFICE :						
Salaries of Office Staff	..	..	Rs.	17,090		
Stationery and Office Equipment	..	..	„	4,500		
Postage and Telegrams	..	..	„	2,500		
Advertising	..	..	„	300		
Telephone	..	..	„	1,010		
Audit	..	..	„	850		26,250
8. TRAVELLING EXPENSES OF STAFF :						
Officers' Expenses	..	..	..	..	..	9,000
9. MAINTENANCE OF BUILDINGS, WATER AND POWER SUPPLY :						
Laboratories and Offices	..	..	Rs.	1,000		
Bungalows	..	..	„	5,000		
Water and Power Supply	..	..	„	1,500		
Furniture Replacements	..	..	„	250		7,750
10. MISCELLANEOUS ITEMS SHARED WITH ESTATE :						
Dartonfield General Charges	..	..	Rs.	21,278		
Nivitigalakele General Charges	..	..	„	11,648		
Hedigalla General Charges	..	..	„	8,080		
Upkeep of Roads and Grounds	..	..	„	1,125		
Factory Upkeep	..	..	„	1,075		
Power Supply	..	..	„	6,887		50,093

11. CONTINGENCIES :

Contribution to London Advisory Committee..	Rs.	22,000	
General Charges	..	1,000	
Insurance Charges	..	4,000	
Staff Provident Fund	..	21,400	
Passages	..	6,000	
Entertainment Allowance	..	150	
War Allowances to Staff	..	49,370	
Contribution to Medical Fund	..	1,950	105,870

12. DEPRECIATION : 20,200

13. PLANTING FOOD CROPS—HEDIGALLA : .. 2,800

Rs. 420,655

CAPITAL EXPENDITURE

BUILDINGS, :

Dartonfield—

1 Senior Staff Bungalow	Rs.	40,000	
Bungalow for Secretary Accountant	..	33,000	
1 Junior Staff Bungalow	..	12,000	
1 Quadruple Labourers' Cottage	..	8,000	
2 Double sets Latrines for Lines	..	800	
Alterations to Laboratories	..	5,000	98,800

Nivitigalakele—

Rice and Tool Store	Rs.	3,000	
Smoke House	..	5,000	
1 Quadruple Labourers' Cottage	..	8,000	16,000

Hedigalla—

1 Quadruple Labourers' Cottage	..	..	8,000
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EQUIPMENT :

Laboratory Equipment for Additional Staff ..	Rs.	3,000	
1 Typewriter & typewriting table	..	600	3,600

IMMATURE AREAS :

Dartonfield	Rs.	421	
Nivitigalakele	..	9,407	
Hedigalla	..	12,169	21,997

Rs. 148,397

SUMMARY

INCOME Rs. 350,397

EXPENDITURE :

Revenue	Rs.	420,655	
Capital	Rs.	148,397	569,052

EXCESS OF EXPENDITURE OVER INCOME Rs. 218,655

